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APRIL 24, 1937

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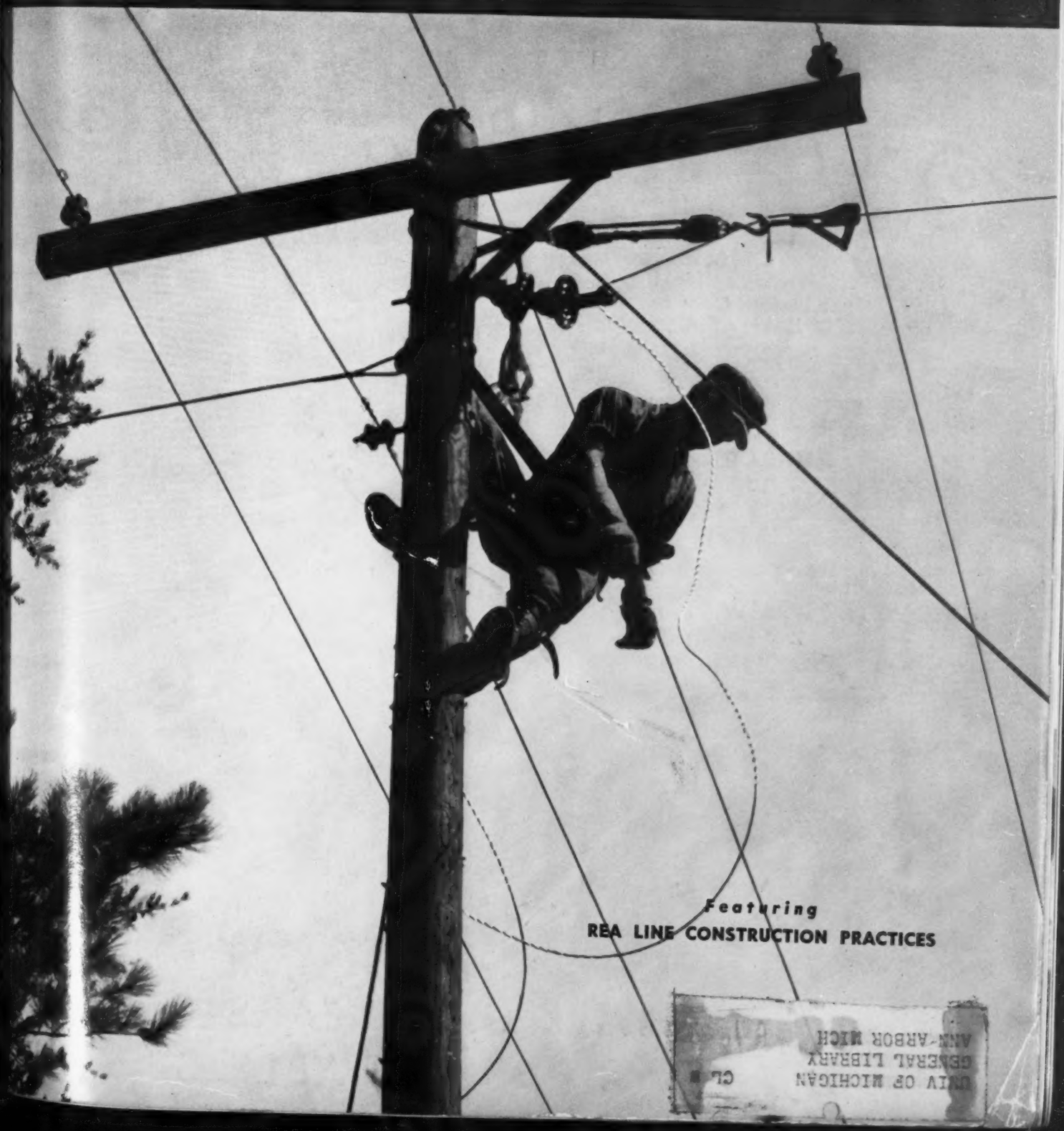

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Central Hudson's commercial manager, H. E. Dexter, emphasizes the importance of selling rural electric service at a profit —to the customer as well as the utility.

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Detailed data on the operations of 183 power systems in the 100,000,000-kw.-hr. class will be in the Annual Supplement to the issue of May 8. The list includes 148 light and power companies in the United States, a larger number than ever before, totaling 93 per cent of the industry.

Cement Plants Modernize Electrically

Rapid strides in the technology of cement manufacture have given rise to the need for advanced electrical equipment for process control, modern powerful electric drives and thorough instrumentation. What the newer plants are using and how the equipment is being applied are to be told in a coming article.

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NEWS OF THE WEEK

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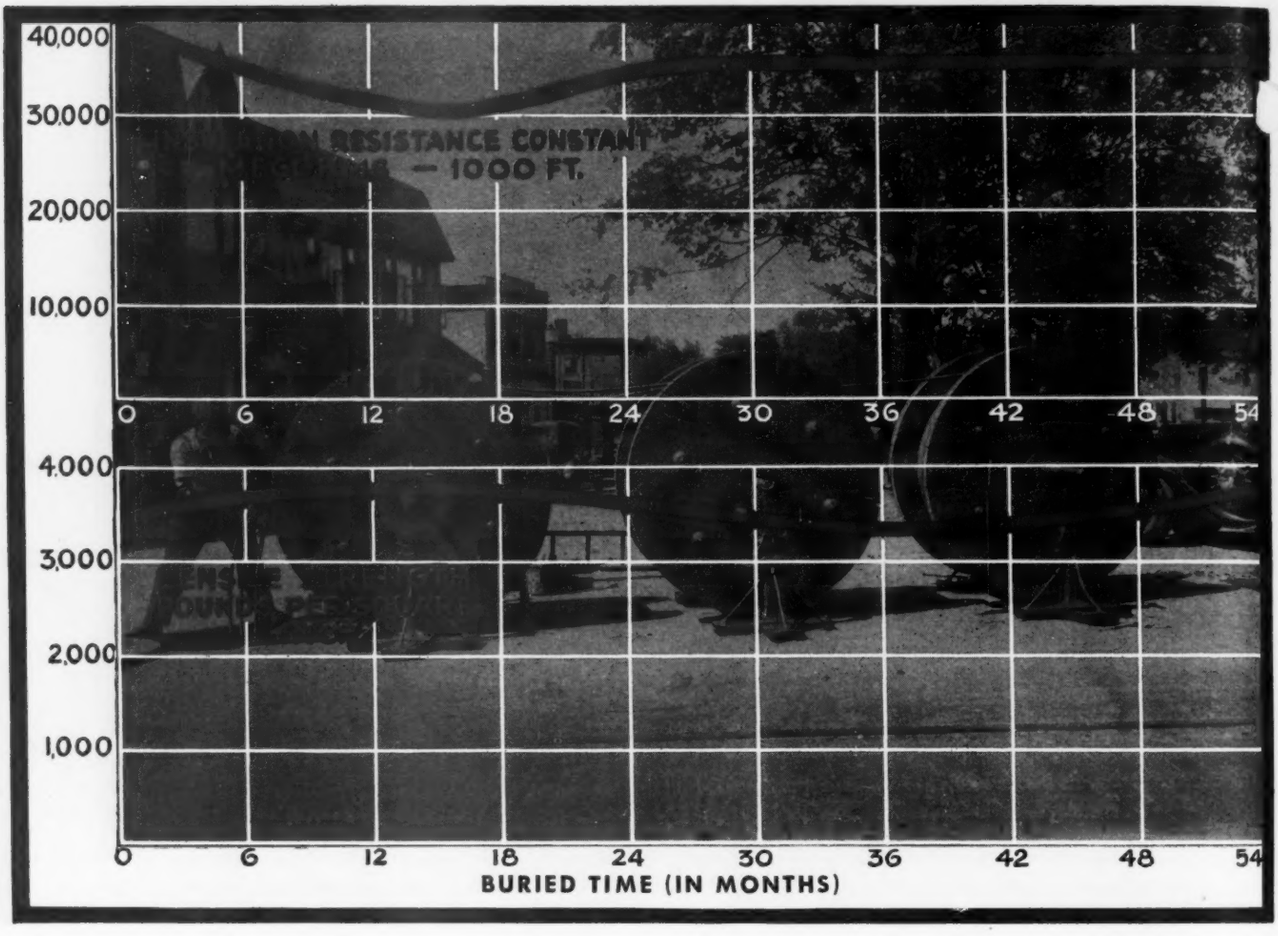

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ELECTRICAL WORLD

APRIL 24, 1937

Build Farm Customer Usage

When one sees from the survey of REA farm line characteristics in this issue the low density of customers—21 per cent of the lines have less than three customers per mile—the question arises how can such lines ever be made to pay. And while the density on utility built lines, as shown in our survey of a year ago, is better, it shows 21 per cent had three or less customers per mile.

If a cost of $1,000 per mile complete is assumed, then, on any basis of figuring that one takes, there is the inescapable fact that with three customers per mile there is $333 investment per customer on which each year the fixed charges of depreciation, taxes and interest must be met, as well as operating and maintenance costs. All of this has to be paid by some one, so that if the line is to be profitable, there must be enough usage to warrant the investment cost.

There is no sales magic in electricity. REA has found that out. Farmers are not stumbling over each other to get electric service even when the government is anxious to help them. And those who do subscribe have, generally speaking, shown little initiative to expand substantially their use of the service. Nevertheless, the average farm customer must use considerably more energy than the average urban cutomer to bring anything like the same return.

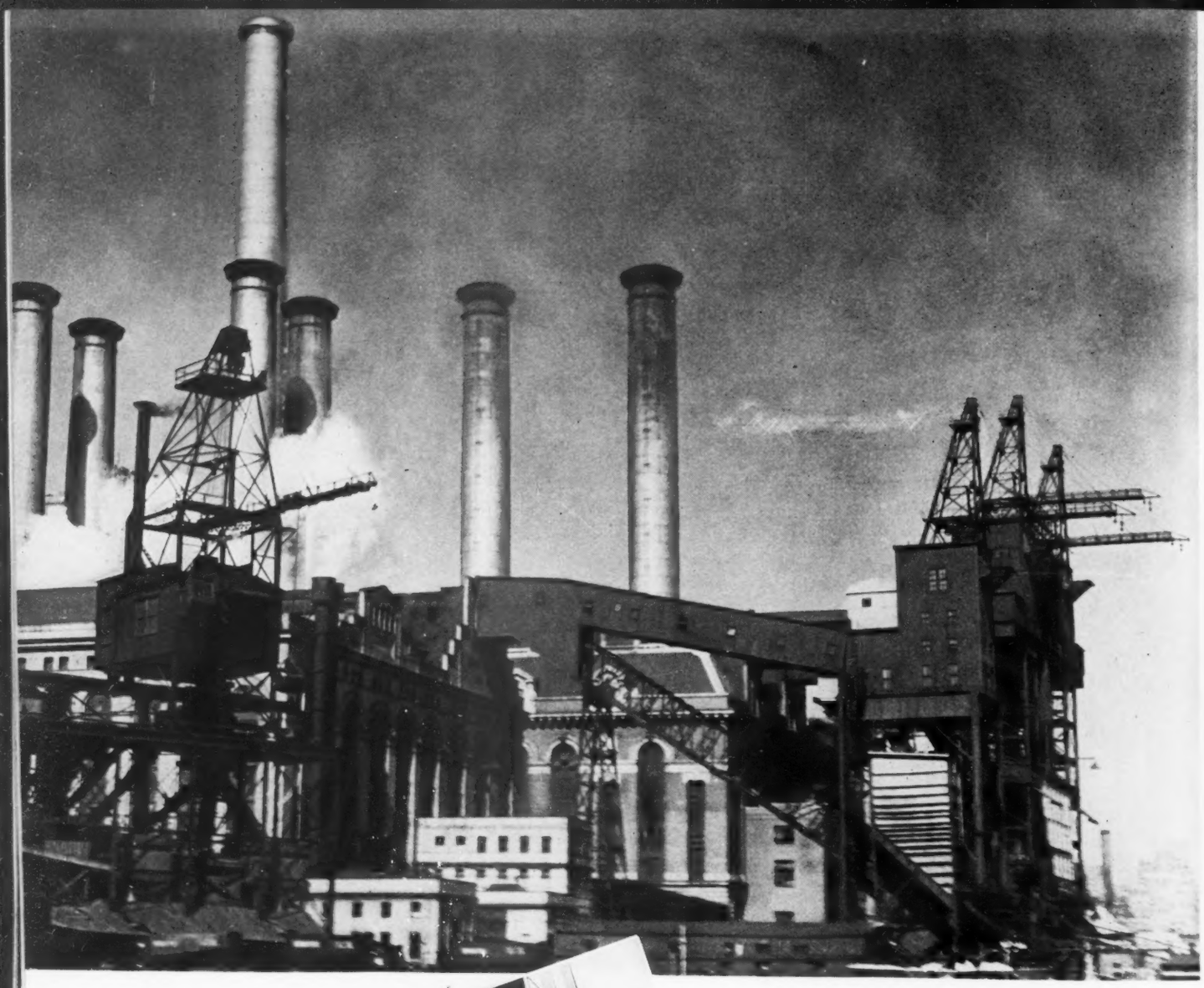
Electricity on the farm has two applications, residential and production. It is unfortunate that too much of the rural use promotion has been directed to the residence. The production or business side of farming can and will use many times the average residential consumption. To do so, however, the farmer must be shown how to apply electricity to his farm operations in a way that will save him labor, money and cut down losses.

There are certain obligations, therefore, on the part of those who are promoting rural service. REA and the electric utility industry have identical problems in building up a rural load. Where there has been co-operation between the two interests, as in certain sections of the South, it will be found that the objectives of the government agency and private utilities are not so very far apart. A greater recognition of the mutuality of interest in rural electrification should be of advantage to both sides.

Every effort should be made to provide the customer with adequate line and transformer capacity and then to persuade the customer that he should have ample wiring to provide for the load he might reasonably have. So far there are no standards available for the wiring of the business side of the farm. This is an obligation that should be met soon. It is also essential that the farmer be provided with some inspection service on his wiring. The need is recognized, but there is too little effort on the part of those promoting rural electrification to lend their full support to securing such inspection.

Then the farmer must be sold the greater use of electric service. When he is taught to use energy in a large way the problem of low customer density will be less difficult and we shall be able to push rural lines out into much thinner territory. The advancement of rural electrification, in other words, is dependent upon how well we serve the present rural customer. If the present customer is permitted to remain just barely profitable or unprofitable, there will be little or no incentive to take on customers likely to be more costly to serve.

Both REA and the utility companies have a common problem here. By this time REA has probably learned that co-operatives left to themselves are of little help in building the load of the individual subscriber. It is ever the problem of the agency that promoted the line in the beginning, and for that reason it seems extremely desirable that REA and the utilities pool their sales ammunition and unite wherever their interests are jointly affected to develop greater customer usage of electric service.



NEW LIFE FOR AN OLD STATION

Savings in system coal consumption of 200,000 tons per year are to be effected by modernization of Waterside plant No. 1, which will require an investment of $12,000,000 by the Consolidated Edison Company of New York. The program calls for removal of some old machines and the addition of two 50,000-kw. topping turbines, bringing the station capacity to 382,000 kw. These turbines will take steam at 1,400 lb. pressure and 900 deg. F. and discharge it at 200 lb. to low-pressure headers. Four new boilers capable of delivering 500,000 lb. of steam per hour will also be added. The station's new 450-ft. stack will improve draft conditions and carry gases above nearby buildings. The first of the new turbines will go into operation this summer and the other some time in 1938. Insert shows the stator of one new unit being unloaded in New York Harbor. It weighs 221,540 lb.

Economic Planning Averts Totalitarian State

Unless Such Public Programs as TVA Are Accepted Prospect Is for Drift Toward Extremes of Collectivism or Individualism

By A. E. MORGAN *
Chairman Tennessee Valley Authority

DURING the past decade we have heard much of economic plans, with Russia as the standard for comparison. One might describe the Russian ideal somewhat as follows:

> The collective will and intelligence, as expressed in government, surveys the resources and needs of the state and its people, and then undertakes to organize and direct the use of the whole cultural and economic resources and energies to bring about the greatest total well-being of the state and of its people. The "totalitarian" governments of Italy and Germany have substantially similar aims, the chief differences being that they have not gone so far in displacing private initiative, and that they claim to use different criteria in determining who shall exercise the powers of government.

Speaking for the average man of fair intelligence, I have a strong intuitive dislike for that type of social organization. I crave a considerable range of individual discretion in both thought and action. If I feel that I have some creative capacity, and if I have confidence in myself, I do not want my chance for adventure and creation to be killed by the unimaginative decision of some bureaucratic official or commission. I want that freedom of personal initiative which will enable me to try out my hopes and plans. However, if my conditions of life are so restricted that my freedom is only freedom to starve or to be but a routine cog in a great economic machine, then I may see more of freedom and opportunity in a socialized economy or in a totalitarian state. My decision is apt to be a pragmatic rather than a philosophical one. If I am an average man I will take the course which in my personal case seems to offer most of freedom and of opportunity. Unless I am unusually critical, my political philosophy may vary with changes of the economic cycle.

One of the best known labor economists in America recently remarked that as a rule a workman does not join a union until he has given up expectation for individual advancement —until he has concluded that he has more to gain from group action than from individual action. In most cases his decision is based on his impression of where his personal interest lies, rather than on any theoretical social philosophy.

In my opinion the continuance of individual and social progress demands that men shall continue to hold the pragmatic "on-the-fence" attitude as between individualism and collectivism. We need increase of insight, imagination and character which help to interpret conditions, rather than a giving up of this pragmatic position.

I believe that Russia and Italy and Germany will be forced to abandon extreme collectivism in spite of any short time spurt of efficiency it may produce. If that extreme collectivism should be realized and should spread as a result of the quick increase of obvious efficiency which uniform collective action may achieve, I think that such collective regimentation might bring on the twilight of human progress.

Wide World

A. E. Morgan

On the other hand, that rugged individualism, which would limit governmental activity to keeping the peace and to preventing injustice, also is a totally inadequate basis for society. There are problems which transcend individual initiative, and which can be achieved only by collective effort, sometimes on a vast scale. To try to thwart such collective action because it limits freedom of exploitation of a privileged few, or because it goes against traditional attitudes, is in its effect anti-social. No great civilization can survive today and remain wholesome and vigorous without large elements of collective action. How to steer a mean course between extreme collectivism on the one hand and extreme individualism on the other is not a problem of abstract political theory, but of practical case-by-case judgment. The wisdom, the vigor and the social-

* Condensation of recent address at University of Minnesota.

Essence of Dr. Morgan's Philosophy

I do not subscribe to the "all or none" philosophy, which would have the government take over all our economic life or else leave all of it to private initiative. In my opinion some things can best be done by private initiative, some by public undertakings, and some by a combination of both. The best economic society will be the one which is wisest in determining what shall be private and what public, and which provides the best administration, both public and private, after the decision is made.

minded integrity with which we steer that course will have much to do with determining the success of our order.

The rugged individualists are wont to say that either our country must be wholly individualist or wholly socialized, and that collective action in one field is but a first step toward complete socialization. Not only do I hope and believe that is not the case, but I believe that intelligent collective action in those phases of our life where private initiative is totally inadequate may prevent a blind mass movement toward indiscriminate collectivism. Those who would preserve private initiative can do so best by claiming for it only those fields where its superiority can be demonstrated in actual practice.

TVA a model of economic planning

Now, let me get down to cases in the TVA. I shall try to describe some situations where in the past a high degree of rugged individualism has been in control, and where in my opinion collective action on a great scale is essential to the social good. Let us take the case of the control of the Tennessee River. Here is a great river system draining an area of 42,000 square miles, about the size of the state of Ohio, and extending through parts of seven states. Several years ago the federal government adopted the policy of making this stream navigable. That job was out of the reach of any private organization, or of any single state. It necessarily was a collective activity of the national government, as part of a great system of inland navigation which gradually is coming into being.

But the Tennessee also is subject to floods. Not only are cities along the stream itself greatly damaged, but the river adds greatly to flood stages on the Ohio and Mississippi. No single community along those rivers working alone can protect itself at reasonable expense. A great social effort is necessary. Moreover, navigation and flood control can be co-ordinated so that the two purposes combined can be secured at less expense than though they were worked out separately. The storage dams which help to prevent floods also regulate navigation stages. In clearing reservoir sites along the river, property which formerly was subject to flood damage is removed or vacated.

Then, also, the Tennessee River has large possibilities for hydro-electric power. It is not only desirable but necessary to combine power development with flood control and navigation. The damsites which are most suitable for power development also are necessary and the only good ones available for navigation and flood control. It is cheaper to secure those three objects together than to work them out separately.

TVA transcends private initiative

Even considered as a power project alone the unified control of the Tennessee River transcends private initiative. If different private companies should build independent projects on different parts of the river system there would be lack of that integration which makes for the most economical power development.

The Wilson Dam at Muscle Shoals on the Tennessee River is a "run-of-the-river" plant. That is, there is very little storage above the dam, only enough to regulate the river for a day at a time. The flow of the Tennessee River varies greatly between high and low water. In high water periods there is enough water supply to generate more than half a million kilowatts of electric energy. During very dry seasons less than a tenth as much power can be developed. Now, as most of you know, it is only continuous power, or prime power as it is called, which has a high market value. Power which is available for only six or eight months in the year is worth but a fraction as much. Because the continuous power it will supply is so small, the Wilson Dam taken by itself is not highly profitable as a power development.

Hundreds of miles upstream on the Clinch River, a branch of the Tennessee, the TVA has built the Norris Dam and power plant, which is of a very different character. This dam forms one of the world's largest reservoirs, which will store almost a year's flow of the river above. During the winter and spring, when there is enough or too much water in the river below, the Norris Dam is closed and the water stored. Then during the dry season it is used to make power when power is most valuable, and when the Wilson Dam has the lowest supply. But that is not all. The water which passes through the Norris Dam power plants flows down river to Wilson Dam and about doubles the low water supply there. There are eight present and prospective dams in the TVA program on the Tennessee River below the Norris Dam, and the water released from the Norris Dam in very low water will about double the power at each of the dams below. The Norris Dam taken by itself would not be a highly profitable power development, but when we consider how it can be regulated to about double the prime power supply at eight other dams downstream, we can see the value of a single integrated power system for the entire river.

Benefits in integration

There are other benefits of an integrated system. For instance, the Chickamauga Dam, now being built by the TVA on the Tennessee River, is primarily for navigation, but will develop power as well. It differs from Wilson Dam below in that it has a relatively low head, about 50 feet at ordinary river stages. In flood season it is almost drowned out and will produce no power, while in very dry seasons it also could by itself produce little power.

Wilson Dam below is a high dam. Not only is its power not reduced during floods, but those floods supply water for a very large increase in the amount of power which can be generated. Therefore, in high water sea-

[*Continued on page 114*]

Chrysler Keeps After Power Factor

Correction of Power Factor Performs Three Functions — Makes for More Efficient Use of Energy at Machine Drives, Allows Full Utilization of Transformer Capacity and Reduces Power Bill — Value of Capacitors in Small Units

By H. E. WATTERSON
Works Engineer, Chrysler Plant, Chrysler Motor Corporation, Detroit, Mich.

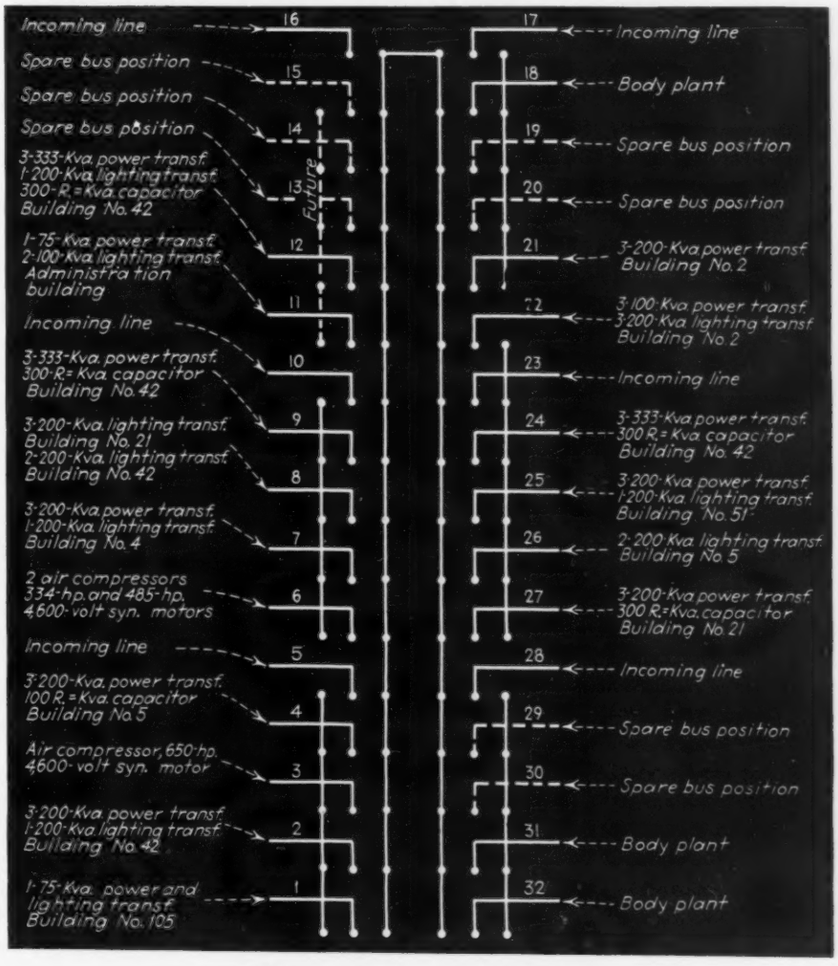
NOTHING stays put in a motor car manufacturing plant. It is not only that changes in the model of the product necessitate changes in methods of manufacture and rearrangements in production processes, there are, as well, continuous improvements in the machines and equipments used in production, and no automobile maker can afford to operate obsolete machinery, not if he expects to keep, or hopes to advance, his place in the field. Therefore, power-factor correction, an element in efficient plant operation, is a job that is never done. But even if you can't get it done, still you can keep on top of it. That is what we try to do at the Chrysler plant of the Chrysler Motor Corporation.

Some years back electrical men occupied with the practical problems of industry began to realize that the harmful effect of low power factor was real and not just a bogeyman raised by the theorists. Singularly enough, it was about the same time that utilities started to insert power-factor clauses in their industrial rate schedules. Perhaps there is a connection between the two events. But be that as it may, power-factor correction has been recognized for a long time as an important consideration in the efficient use of electric power in Chrysler plants.

Synchronous motors for air compressors and motor-generator sets had been used in the Chrysler plant for power-factor correction even back in the days when it was the main plant of the Chalmers Automobile Company. It had been operated as a Chrysler unit for several years and many rebuildings and extensions had been made when it became apparent that adequate correction was beyond the capacity of synchronous motors then operating, or that reasonably could be installed. Something more was necessary.

A detailed load study was made, covering every drive in the plant, and, as usual, more motors were bound to be under- than over-loaded. There was a general shifting around of motors, with not only a resulting improvement in power factor but also a more

[*Continued on page 50*]



Scheme of primary distribution

The original plan called for six main buses in the service entrance substation with an incoming power line supplying each one. However, only five were installed and the sixth power company line (position No. 16) is connected to the tie bus. The outgoing lines feeding lighting service alone or on which lighting is a major part of the load, as in the cases of the three lines to the body plant, required no power-factor correction. The reactive capacity was installed on the lines feeding large power loads. The synchronous motor-generators mentioned in the text will be installed on the lines from bus positions Nos. 13 and 24, releasing 600 r.-kva., which will be distributed as required on other lines.

Building Load on Rural Lines

Ten-Year Record Exposes the Necessity for Increased Customer Equipment—Specific Appliances Suggested to Raise Farm Usage

By H. J. GALLAGHER *
Farm Service Supervisor Consumers Power Company

The problem of building sturdy low-cost lines has been solved to the extent of rendering service to 653,000 farms between 1926 and 1936. During this time the cost per kilowatt-hour has also been greatly reduced, until at the present time agriculture is receiving service at rates undreamed of a few years ago. The research program on electric application has developed over 150 uses for electricity that have practical application on the farm; the equipment for these uses has been designed, manufactured and is on the market. What has been the response of agriculture?

FOR a number of years the Consumers Power Company has been extending rural service. Our records for the past ten years show that in 1927 we were serving 1,299 farm customers, the average annual consumption was 440 kw.-hr., the average cost per kw.-hr. was 9.34 cents and the annual revenue per customer was $41.10. On December 31, 1935, we were serving 18,460 farm customers, the annual consumption was 751 kw.-hr., the average cost per kilowatt-hour was 3.77 cents and the annual revenue was $28.37. Reducing the cost of energy 59.6 per cent increased the use of energy only 71 per cent and reduced revenue 31 per cent. To have kept pace with the rate reduction the consumption during 1935 should have been 972 kw.-hr. instead of 751. The high peak of consumption was 755 kw.-hr. in 1929. Those figures rather definitely discount the theory that lowered rates are the basic requirement in building load; rather, *it emphasizes the necessity of associating better load-building programs with reduced rates to maintain an equitable revenue.*

What has happened during this period of ten years to have kept the annual consumption on so low a level? It is true agriculture has been in financial difficulties, but usually when an industry is in distress its first move is to reduce operating costs. Obviously agriculture didn't attempt to use electricity for this purpose. This gives rise to the following questions:

1. Do farmers appreciate the value and economy of electric operation?
2. Is electricity a factor in reducing the costs of farming operations?
3. Are we trying to sell the farmer something he can't afford?
4. How much can the farmer afford to invest electrically?
5. What should be the annual consumption on the average farm?
6. What is an average farm?

Familiarizing the farmer with the value of electric operation is strictly an educational program. Regardless of the kind of educational program pursued, it is important that it be concentrated on the right group. Any group of customers may generally be divided into three classes. In the first class will be the aggressive type, the leaders, those who carry on without much assistance. Approximately 3,000, or about 15 per cent, of the 25,000 farm customers served by our company are in this class. Another class would be those who can go but a very limited way with any program. It is estimated that this group is also about 15 per cent of the total.

Between the two extremes is the great bulk of the so-called average customers, living and farming on average farms; in this case about 19,000. This is the group that will profit through educational programs, this is the group that will make educational programs profitable to the utility.

What is this average farm? How large? What are the farming practices? What is the total investment? What per cent of the total investment would be a reasonable electric investment? To what extent will the farm income support electric operation?

In an attempt to answer these and similar questions, an analysis was made of the farms in the agricultural areas of the Lower Peninsula of Michigan.

The analysis reveals the average farm as:

Table I

80 acres at $60.00	$4,800.00
10 cows at $80.00	800.00
3 horses or tractor	500.00
100 hens	125.00
Hogs or sheep	75.00
Machinery, tools, etc.	1,500.00
Total	$7,800.00

On this average farm or any farm with electric service are uses that may be classified as base uses:

Table II

Base Use	Equipment Cost	Average kw.-hr. per Year
Lights	.....	360
Radio	$ 50.00	120
Pumping	100.00	360
Washing machine	65.00	48
Iron	6.00	120
Toaster-percolator	10.00	120
60-amp. service wiring	150.00	...
Total	$381.00	1,128

The $381 electric investment is less than 5 per cent of the total farm investment, but measured by the yardstick of an annual consumption of

* Paper presented at Chicago convention of American Society of Agricultural Engineers.

751 kw.-hr. the investment would be nearer $250 than $381. Consequently, even the base use is inadequately supplied to the extent of about 33⅓ per cent.

To electrify the more common agricultural practices on this farm would result as:

Table III

Use	Equipment Cost	Year kw.-hr.
4½-in. burr mill, grind 18 tons	$ 7.00	360
½-hp. motor	27.00	
Other uses for motor besides grinding	....	60
1 300-chick brooder	25.00	150
2 poultry water heaters	5.00	75
Portable milker	125.00	180
Portable dairy water heater	20.00	360
Total	$219.00	1,185
Base use	381.00	1,128
Total	$600.00	2,313

In this case an electric investment of $600 is only 7.7 per cent of a farm investment of $7,800 and compares favorably with the investment in the auto or the household furniture. The $6 monthly bill may or may not appear formidable, depending upon whether it is incorrectly considered as an additional expense to the farm or correctly considered as a better substitute for present expenses.

Ordinary monthly expenses on the farm where electric service is not available:

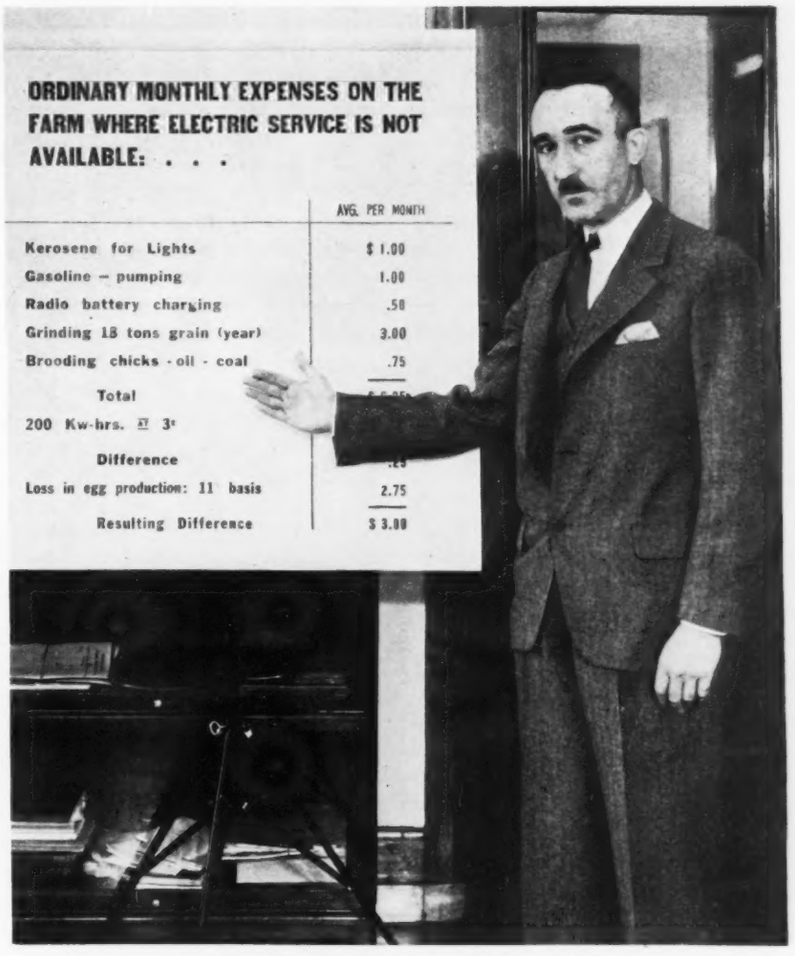
Table IV

	Average per month
Kerosene for lights	$1.00
Gasoline—Pumping	1.00
Radio battery charging	0.50
Grinding 18 tons grain (year)	3.00
Brooding chicks-oil-coal	0.75
Total	$6.25
200 kw.-hr. at 3 cents	6.00
Difference	0.25
Loss in egg production: 11 per cent basis	2.75
Resulting difference	$3.00

Or considering the time, expense and labor saved in milking, the utility use of the motor, water heater, iron and washing machine as the equivalent of $2.75, the resulting difference between electric costs and non-electric costs would be $3.

All farms naturally would not have the same agricultural characteristics. Some would be more inclined to poultry than dairy, and *vice versa;* others may be of an entirely different type. It makes little difference; from more than 150 practical uses of electricity on the farm a proper selection may be made to stay within the limits of a reasonable investment and effect sufficient savings or earnings to more than offset the monthly bill.

If the farm is more inclined to poultry than to dairy the dairy equipment in Table III is replaced by additional poultry equipment as in Table V.



The author explains Table IV

Table V—Poultry

	Equipment Cost	Year kw.-hr.
Grinding	$ 7.00	360
½-hp. motor	27.00	60
600-egg incubator	125.00	300
2 500-chick brooders	80.00	500
Poultry lights	15.00	90
Poultry water heaters	25.00	375
Total	$279.00	1,685
Base use (Table II)	381.00	1,128
Total	$660.00	2,813

Where the major operation is dairy, the poultry equipment of Table No. 5 may be replaced by dairy equipment as in Table No. 6.

Table VI—Dairy

	Equipment Cost	Year kw.-hr.
Grinding	$ 7.00	360
½-hp. motor	27.00	60
Milker	125.00	180
6-can immersion cooler	300.00	1,000
Portable water heater	20.00	360
Total	$479.00	1,960
Base use (Table II)	381.00	1,128
Total	$860.00	3,088

A common practice on many farms is to milk by hand, sell cream, brood a few chicks under hens and raise a few acres of small fruits and vegetables; the poultry and dairy equipment can be replaced by other equipment more applicable to the farming program as:

Table VII

	Equipment Cost	Year kw.-hr.
Porous hose irrigation system—3 acres	$100.00	
Centrifugal pump	30.00	
¾-hp. motor	60.00	
270,000 gal. of water pumped	.....	500
60,000 gal. of milk separated	.....	60
240 ft. of soil-heating cable and thermostat	41.00	
20-day operation	.....	320
Grinding equipment	34.00	420
Total	$265.00	$1,300
Base use (Table II)	381.00	1,128
Total	$646.00	2,428

Similar illustrations could be made to apply to all types of Michigan diversified agriculture. Based on an average annual consumption of 751 kw.-hr., the average farm customer has an electric investment, including wiring, of less than $300; an additional investment of about $300 in equip-

ment is more than justified from a production or from an earning standpoint. The electric range, the refrigerator or the storage water heater have not been included in this analysis. Of course, they are a definite and very important part of farm electrification, but these three major units should not be held so close to the eyes that sight of other important possibilities is lost.

A $5,400,000 rural appliance market

The value of information of this nature tends to establish a goal, an objective to work toward; it provides a fund of information to present to merchandising agencies interested in the rural electric market. It dispels numerous arguments as to whether the farmer can afford electric operation or not; it emphasizes the fact that farmers have to spend money to farm; that if the amount they normally spend for poor electric substitutes was converted into electric operation, it would be of mutual benefit to the utility and the customer.

If this analysis is correct to the extent that the average farm can afford and should invest an additional $300 in electrical equipment other than domestic, we have an immediate market on 18,000 average farms totaling 5.4 millions of dollars.

How is this market to be supplied? Who is going to do the job? These questions have bothered utilities, manufacturers and dealers since the beginning of rural electrification. I do not know the answer. As far as our company is concerned we do not merchandise farm equipment; not even water systems. We are co-operating with local dealers and manufacturers in the development of the farm market. Last spring I discussed this subject in nine sectional meetings of the Michigan Retail Hardware Dealers Association. This group is interested in rural sales, and the better appreciation they and all other dealers have of the farm market the better results we can expect in getting equipment on the lines. At the present time we have nine agricultural engineers in the field whose job it is to correlate these activities and assist the farmer with his electric problems. They are employed on a straight salary basis; they do not sell merchandise; rather, they sell the value of electric service.

We find that the dealers are beginning to do a better job of selling; they attend local educational meetings, furnish equipment and assist with demonstrations. They are also beginning to carry a more complete line of motors and a greater variety of other equipment.

Each week a report is released to the newspapers throughout the territory showing where the new lines are to be built. This provides all the dealers an equal opportunity to promote sales.

This is of course but one phase of a load-building program. Advertising, methods of merchandising, demonstration farms, group meetings, motion pictures, radio broadcasts and local news releases are other factors in the utility load-building program that deserve a similar factual analysis.

Chrysler Keeps After Power Factor

[*Continued from page 47*]

efficient use of electricity, both apparent in their effect on the power bill. Since that time a very close check has been kept on the motorization of new machines going into the plant, because there appears to be a determined tendency among machine manufacturers to equip their products with oversize motors. The result of this work shows in the not unreasonable 1934 and 1935 power factors in the tabulated record.

But it is impractical to pursue power-factor correction in the higher ranges by watching motor loads. When the percentage gets up to around 80 it is time then to think about adding reactive capacity to the system if it is desired to penetrate the rarefied atmosphere of the upper reaches. In the Jefferson plant there remained no more large drives to be changed over to synchronous motors and, therefore, recourse must be had to static condensers for further improvement.

This decision made, the need of a further one followed right along on its heels. If correction were to be for the single purpose of profiting by the power-factor clause in the electric rate, it would be sufficient to install high-voltage capacitors in rather large ratings at the point of service entrance. But if correction were to be effective, as well, toward more efficient utilization of transformer capacity at the various step-down points in the plant, the installations would have to be made on the secondary side. The former alternative would require a lower investment in reactive capacity. But the value of high power-factor loadings on the transformers outweighed the greater cost of low-voltage condensers and the decision was to place them on the secondary side. Also, it was decided that for flexibility the capacitor units should be of fairly small size.

Many small units adopted

Accordingly the transformer banks operating at lowest power factor were determined and capacitor installations made at those points. The condensers purchased were in 10 r.-kva. units, 130 of them. Four installations of 300 r.-kva. each and one of 100 r.-kva. were made, as appears in the diagram of lines going out from the service entrance station. The installations operated as shown on the diagram from December, 1935, until the seasonal let-down of production for tooling up for new models in the summer of 1936.

Among the new machine tools installed for production of 1937 models are several crankshaft lathes and grinders that require direct-current drive. The direct current is supplied by two motor-generator sets, each powered with a 300-hp. synchronous motor. These motor-generators are operated for power-factor correction and are connected at two of the 1,000-kva. power transformer banks in building No. 42 (see diagram), which is the machine shop. At these banks some or all of the condenser capacity can thus be released for service elsewhere. Herein lies the value of the small size capacitor units which may be assembled in banks of different capacities as required at the places of new installation.

From this brief recital it is clear that power-factor correction in an automobile plant is a continuing problem, never to be finally solved with the engineer walking away from a finished job while he dusts his hands together and says, "That's that." On the contrary, it is a matter that demands close watching and prompt action as conditions change. Otherwise the works engineer will wake up some morning with a low power factor staring him in the face and with the whole job on his hands to do over again from the ground up.

Simplified Protection of Grounding Transformers

Overcurrent Relays Arranged to Clear Transformers on Faults of Any Nature

Grounding transformers are common practice in establishing a neutral connection for limiting stresses and for providing a zero sequence current for relaying ground faults. Prevailing schemes involve a thermal relay, three overcurrent relays and a ratio differential relay. The author has rearranged the layout to dispense with the latter and, occasionally, one of the overcurrent relays.

By GIUSSEPPE CALABRESE
System Engineering Department, Consolidated Edison Company, New York

CUSTOMARY protection of grounding transformers against overheating during ground faults and internal faults as typified by one scheme of protection includes

(a) One thermal relay to protect against overheating during through faults involving ground.

(b) One ratio differential relay to protect against internal faults involving ground.

(c) Three standard overcurrent relays which protect for internal faults not involving ground.

With through faults involving ground current flows in the three overcurrent relays as per item c, thus, in order to prevent false trippings the three overcurrent relays must be made selective with other relays on outgoing feeders.

As an alternate, the scheme used on the system with which the author is connected requires:

(a) One thermal relay to protect against overheating with through faults involving ground.

(b) Three overcurrent relays to protect against internal faults of any kind.

With fault located outside the grounding transformer no current, or zero sequence currents only, can flow in the transformer connections to the system, depending on whether the fault involves ground or not. If, however, the fault is on the primary winding of the grounding transformer, both positive and negative (if the fault is unbalanced) or only positive sequence (three-phase faults) will flow from the system into the fault through the transformer terminal connections T_1, T_2, T_3. The same thing happens with faults involving two phases or more on the delta side of the transformer winding. A line-to-ground fault on the delta side would cause no flow of current.

Under normal conditions, with no fault on the system, no current will flow in any of the overcurrent relays excepting the components of the magnetizing currents of sequence other than zero.

With a through fault involving ground the zero sequence currents flowing in the grounding transformer will cause currents to circulate inside the delta of the current transformers. No current will flow in the overcurrent relays excepting as may be caused to flow by current transformer inaccuracies.

The overcurrent relays may, therefore, be made instantaneous and may be given a very low pick-up, thus affording a fast and sensitive protection against internal faults of any description, including those, such as turn short circuits and faults close to the neutral, which may cause small currents to flow in the relays.

The currents flowing in the three overcurrent relays with a fault in the grounding transformer are shown in Figs. 2 and 3. In Fig. 3 the values taken by the currents flowing in the overcurrent relays with faults on the conventional type are also shown. The symbol E indicates the generator line to neutral internal voltage. The impedances Z_0, Z_1, Z_2 are, respectively, the impedance to zero, positive and negative sequence currents of the

[*Continued on page* 132]

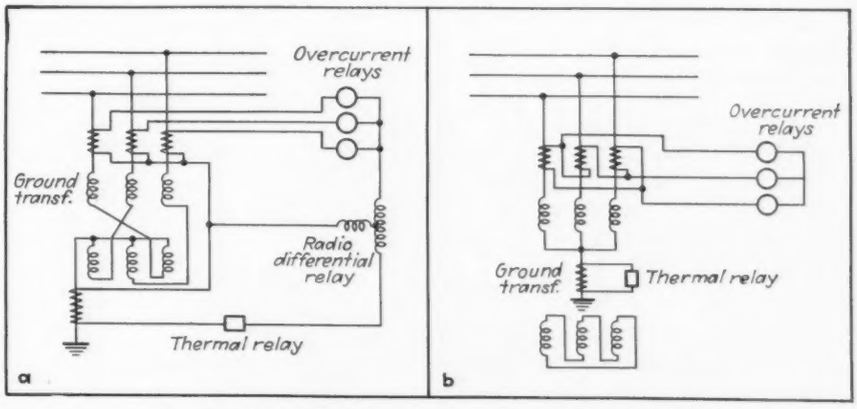


Fig. 1—Grounding transformer protection simplified

Using the connections of (b) instead of (a) makes possible omission of the ratio differential relay. In (b) a fault of any kind in the grounding transformer windings (excepting a line-to-ground fault on the delta side) will cause currents of negative and positive (line-to-ground, line-to-line, line-to-line-to-ground faults or short circuits between turns) or of positive sequence only (three-phase faults) to flow in the overcurrent relays.

Application of Sodium Light

Suggestions for Maximum Value and Effectiveness of Sodium Installations — Characteristics of the Highway Lighting Circuit — Cost Estimate for Series System

By GEORGE A. EDDY
Illuminating Laboratory and Lighting Sales, General Electric Company, Schenectady, N. Y.

MAXIMUM safety and attractive appearance demand that modern lighting equipment be installed according to modern good practice. So great are the possibilities of future expansion of highway lighting, however, that careful planning is doubly important at present, for the sake of promotional value.

Of course it is sensible to apply highway lighting where it can be useful; that is, where it can eliminate an actual or potential hazard. If, in addition, the installation is well planned and well constructed, it will automatically satisfy the requirements for future promotional use. An intersection, grade crossing, traffic circle or other danger point should be the preferred location for a small number of sodium luminaires. An installation of one or two luminaires is of little value in demonstrating highway lighting as such, and for this purpose it is strongly urged that a stretch of at least a mile length be lighted. Experience has shown that shorter installations are traversed too quickly to enable the motorist to get fully acclimated and considerable value is lost thereby.

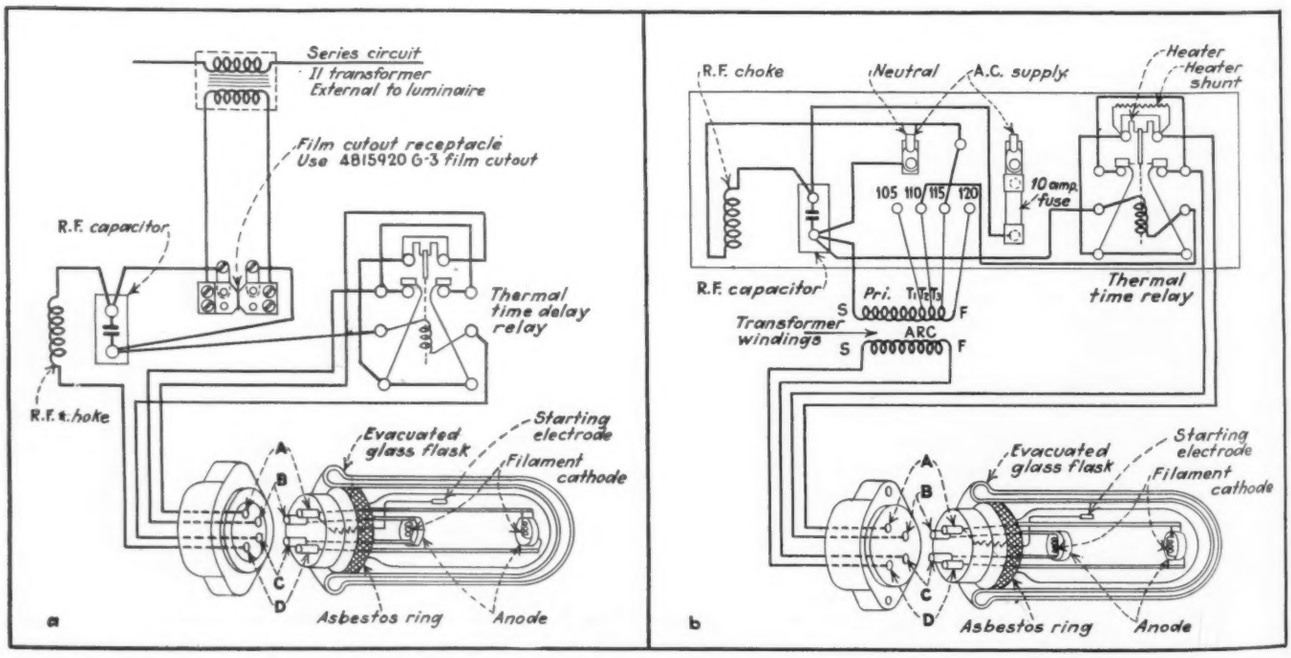
Intersections and traffic circles usually require individual study for each project. The principle to be followed is that, since seeing by silhouette against the lighted background is most effective, the luminaires should be so placed that they will be just beyond the place where an approaching motorist is supposed to see the obstacle if it is present. Local conditions will govern the number and placing of luminaires.

In a previous issue the author outlined the characteristics of the 10,000-lumen sodium lamp. Here he indicates points to be observed for most effective application for highway lighting

For highway lighting the recommendations for an effective installation are conveyed in Table I, which prescriptions are in agreement with the present recommendations of the Illuminating Engineering Society.

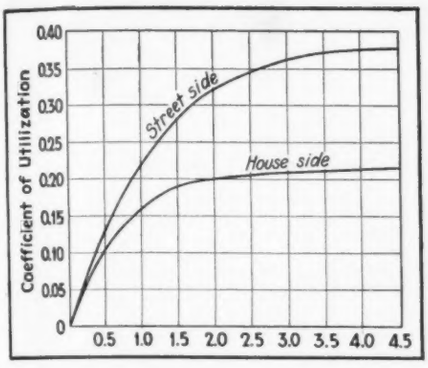
It will be observed that the ratios of spacing to mounting height are 8:1 for preferred and 10:1 for minimum lighting. These should be maintained in cases where longer spacing or lower mounting height may be necessary, to prevent low brightness over excessively large pavement areas.

Visibility by silhouette, which occurs at the majority of places on the highway, depends upon the existence



Wiring diagrams for sodium luminaire. Shown at left is the wiring for series circuit, at right for multiple

to the Highway



Utilization factor of type AM-2 sodium luminaire

$$\text{Ratio} = \frac{\text{Width of street}}{\text{Height of unit}}$$

Effective lumens = coefficient of utilization × bare lamp lumens

$$\text{Ave. F.C. on street} = \frac{\text{Effective lumens}}{\text{Spacing} \times \text{width of street}}$$

Calculations based on units on one side of street or staggered position. Spacing denotes distance on center line of street between adjacent units

of a background brighter than the obstacles. It is well established that, even on a so-called diffuse pavement, light striking the pavement in a direction away from the observer is of little value in building up pavement brightness. It is light coming toward the observer that produces this desired effect. Hence, it is essential that all parts of the pavement and shoulders receive a substantial volume of light from luminaires ahead of the observer.

It is essential that the luminaire beams overlap by much more than a small distance at the center of the span; the beams from each luminaire must extend right up to the next luminaire on each side, else there will be areas of apparently low brightness immediately beyond each luminaire. These are the findings of extensive research with a model highway at Nela Park, verified by field observations.

This factor and the necessary restriction of candle power to less than 4,000 maximum to limit objectionable glare, impose the limitation on spacing between units and advise staggered arrangement and the mounting over the pavement. The utilization factor chart shows adaptability of the type AM-2 luminaire to conventional spacing and mounting heights.

Sodium luminaires have been used with conspicuous success for bridges also. The illumination requirements for safety are likely to be greater than for a highway, since a stalled or slow moving vehicle cannot get off the pavement. Since the architectural design of the bridge will also influence the number and placing of luminaires, individual application recommendations are warranted for each project.

Constant-current transformers of the types designed for incandescent lamp

New York Power & Light crew installing G.E. sodium luminaire in Duanesburg, N. Y. Owned and operated by company under contract with county

circuits will operate series sodium lamp circuits satisfactorily. A capacity table is given (Table II) for outdoor pole type units which takes into account load power factor, starting requirements, aging of lamps, normal variations of supply voltage and frequency, ohmic and reactive losses in the usual highway lighting circuit, and the supply of substantially sine-wave current necessary for maximum light output. Straight series operation is from 6.6-amp. circuits only.

Although the energy consumption rating of the sodium lamp is 180 watts, the over-all energy consumption of the luminaire will be greater than this by the amount of energy consumed in the auxiliary apparatus. The over-all energy consumption for a straight series-circuit sodium luminaire is about 195 watts, representing an efficiency of about 50 lumens per watt. For a luminaire with insulating transformers the over-all energy consumption will be about 220 watts, representing an over-all efficiency of about 45 lumens per watt.

Control of constant-current transformers supplying sodium lamps is by no means identical to those used with incandescent-lamp circuits. To compensate for the warming-up period of the sodium lamp, however, it may be

[*Continued on page 118*]

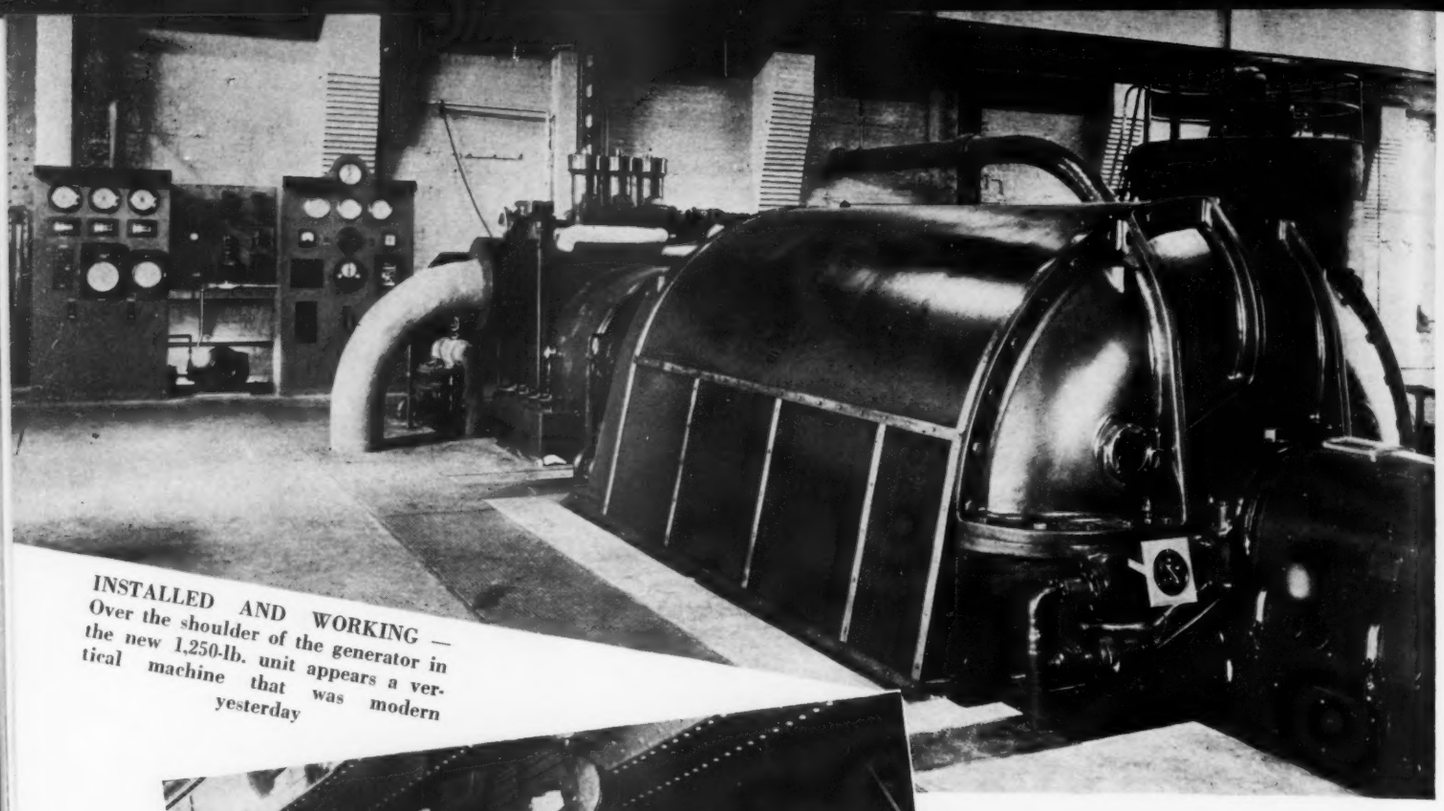
Table I—Recommendations for Placing Sodium Luminaires—Type AM-2 Spacing

		Recommendations				
		I. E. S. Code				
		Lumens per Sq. Ft. on Pavement	Lamp Lumens	Spacing Feet	Lumens per Sq. Ft. on Pavement	Lamp Height, Feet
Pavements Permanently Light in Color						
2-lane	minimum	0.2–0.5	10,000	250	0.38	25
	preferred	.....	10,000	200	0.48	25
3-lane	minimum	0.2–0.5	10,000	250	0.35	25
	preferred	.....	10,000	200	0.43	25
4-lane	minimum	0.2–0.5	10,000	250	0.31	25
	preferred	.....	10,000	200	0.39	25
Darker Pavements—Oil Polished						
2-lane	minimum	0.3–1.0	10,000	250	0.38	25
	preferred	.....	10,000	200	0.48	25
3-lane	minimum	0.3–1.0	10,000	250	0.35	25
	preferred	.....	10,000	200	0.43	25
4-lane	minimum	0.3–1.0	10,000	250	0.31	25
	preferred	.....	10,000	200	0.39	25

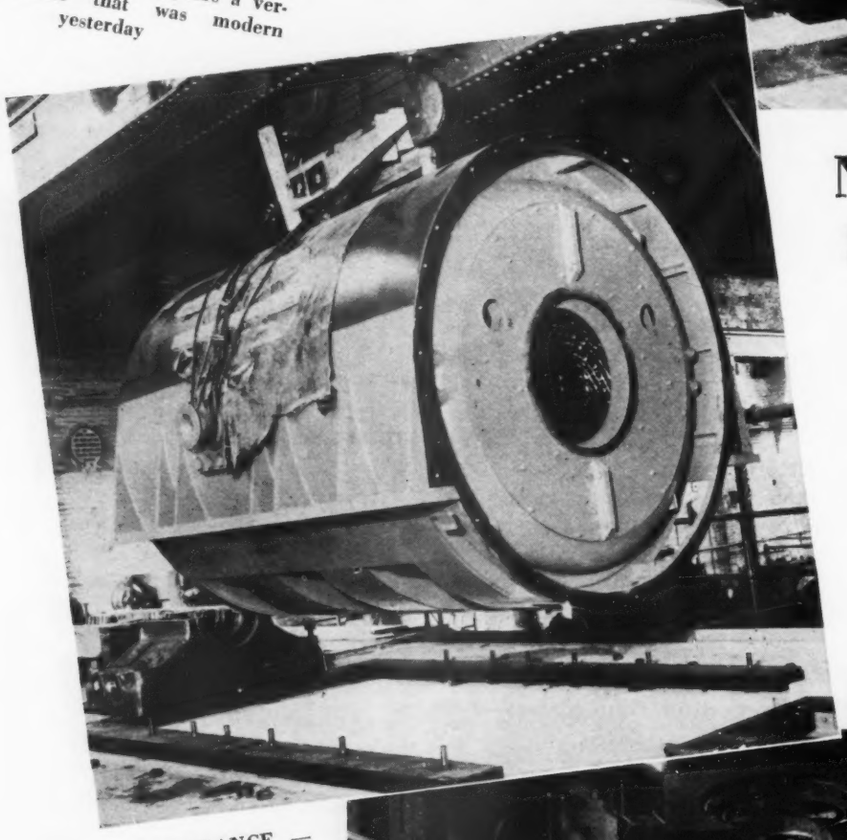
NOTE—Pavements wider than four-lane require specific treatment, which should be recommended only after expert investigation. Very dull, black pavements require special treatment and very much more light.

ARRANGEMENT—For two-lane highways location of lamps on one side only is permissible, but a staggered arrangement is preferred. For three-lane or wide highways staggering is necessary unless spacing is less than 70 ft., in which case use opposite arrangement.

GENERAL—Install lights on outside of curves. Install lights over the pavement, preferably five feet from its edge.



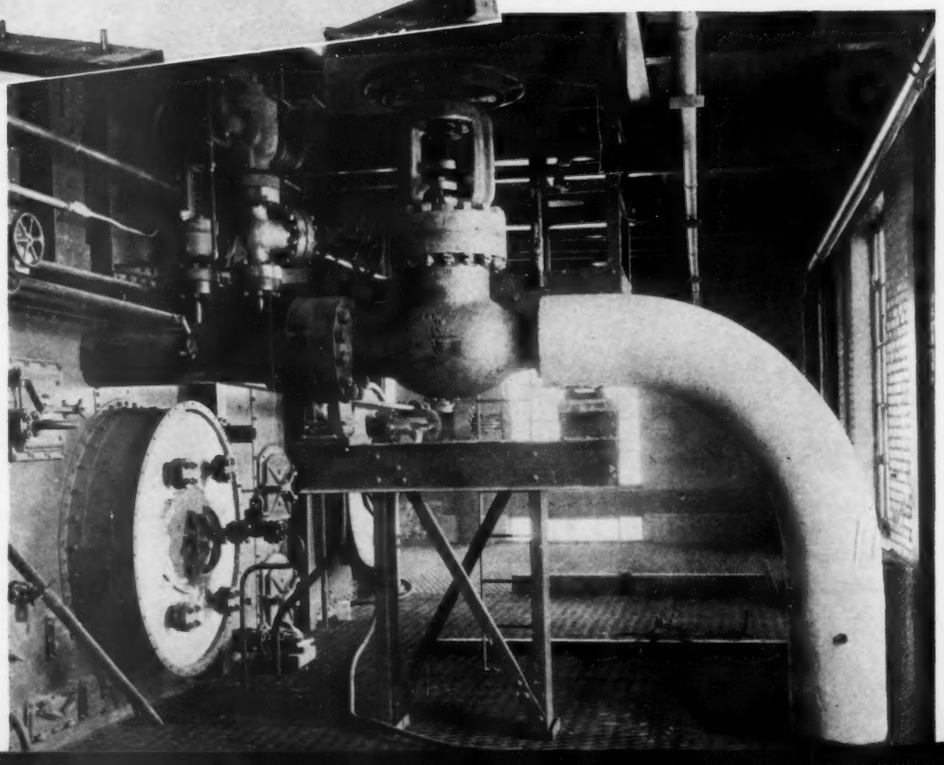
INSTALLED AND WORKING — Over the shoulder of the generator in the new 1,250-lb. unit appears a vertical machine that was modern yesterday



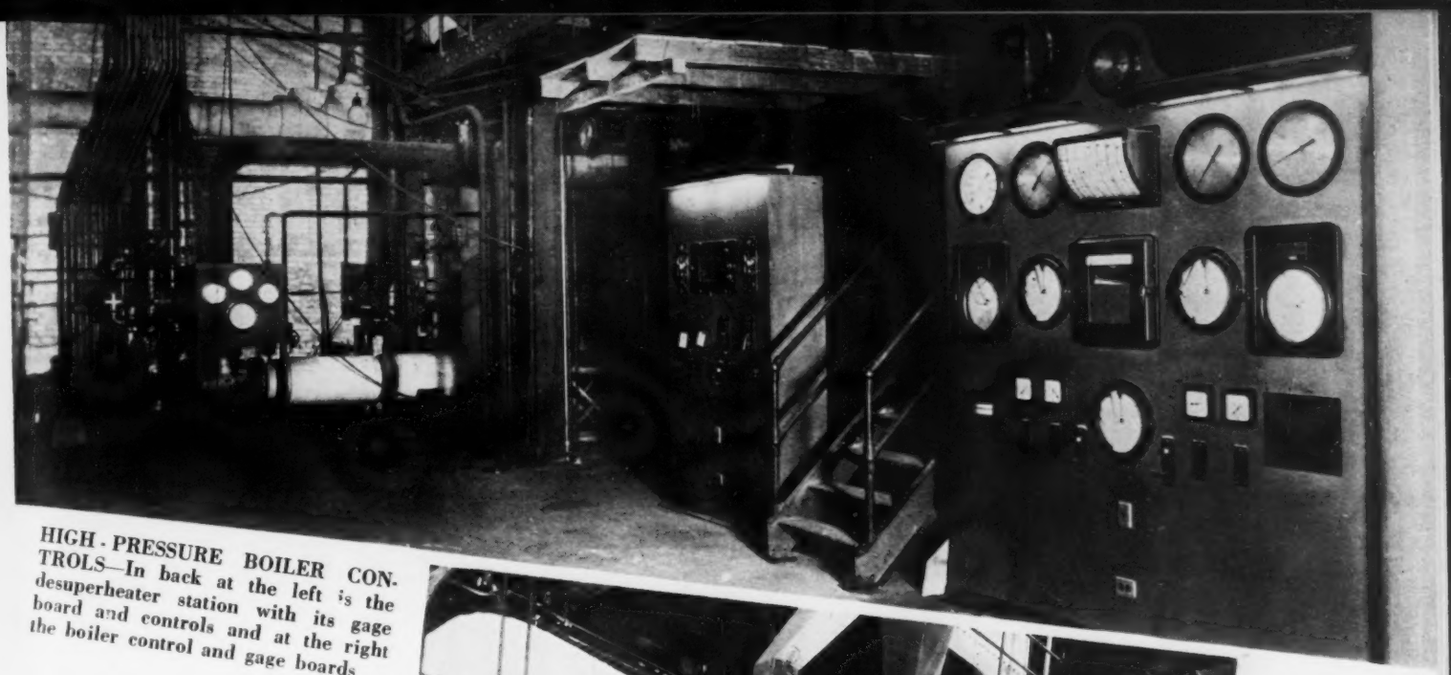
CLOSE CLEARANCE — Typical of the problems that surround the installation of high-pressure units in existing plants whose design, years back, did not contemplate superposition

Nebraska Power's Superposed Unit

When load increase accompanying business recovery demanded addition of capacity to the Omaha plant of the Nebraska Power Company studies were made of three possible ways of doing the job. One was to install a new 15,000-kw. unit of modern design, medium steam pressure (600 lb.), for operation independent of any existing equipment. The two other possibilities were for superposition of a high-pressure machine, the first for use of its exhaust into a 325-lb., 700-deg. F. temperature steam header, from which two 20,000-kw. turbines are fed, and the second in direct connection with a



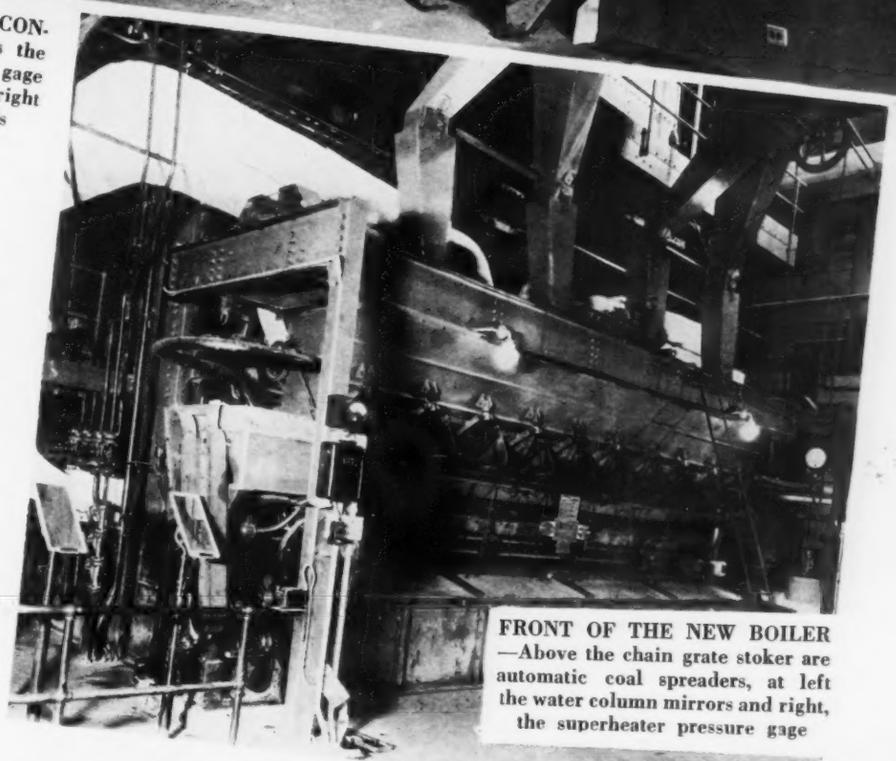
AT THE TOP OF THE BOILER — High-pressure steam comes off in a 10-in. line on which, closest to the boiler, is mounted the automatic relief valve, then the power control valve and next the stop and check valve



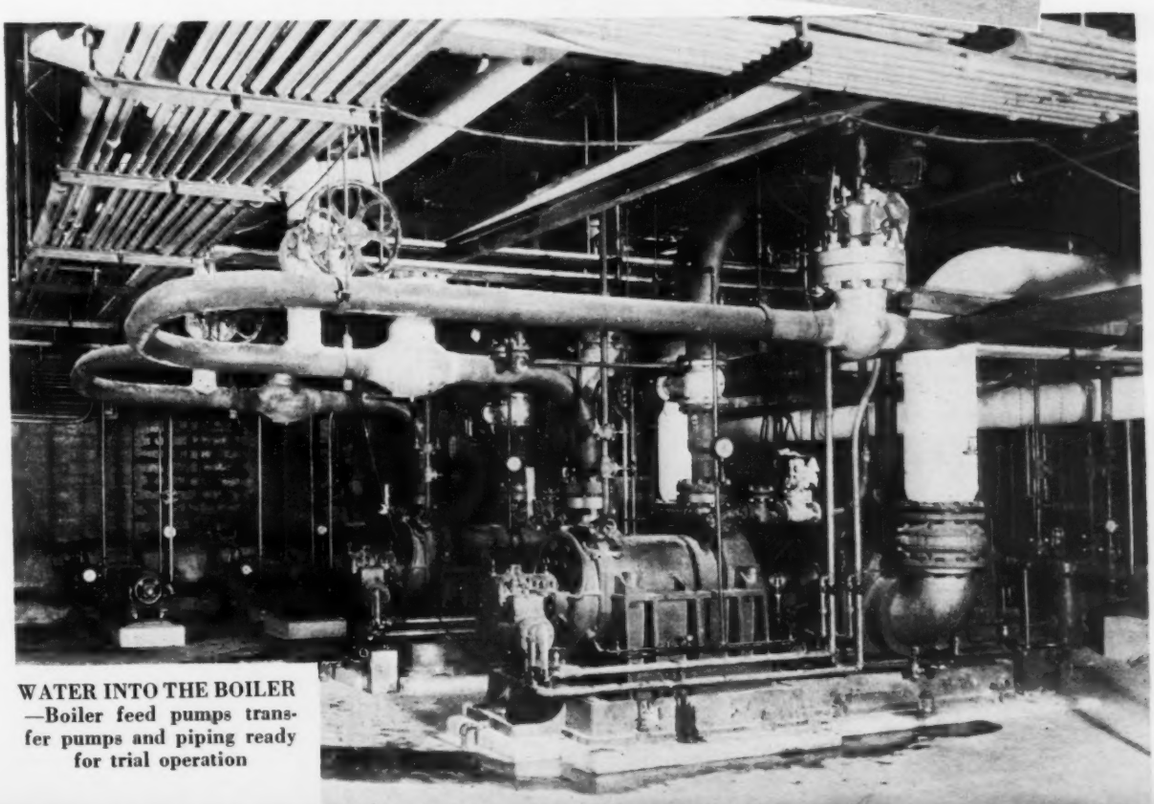
HIGH-PRESSURE BOILER CONTROLS—In back at the left is the desuperheater station with its gage board and controls and at the right the boiler control and gage boards

15,000-kw. turbine operating on 200 lb. steam at 510 deg. F. temperature. Studies indicated the second superposition plan to be most economical. With the 15,000-kw. unit passing about 250,000 lb. of steam per hour, a superposed turbine of 12,500 kw. unity power factor, running with 1,250 lb., 915 deg. F. steam, looked the most attractive.

Completed now, the installation consists of a combustion steam generator of 275,000 lb. per hour maximum rating furnishing heat energy to the high-pressure turbine. Auxiliaries are all equipped with motor drives except the two boiler feed pumps, which are turbine driven.



FRONT OF THE NEW BOILER—Above the chain grate stoker are automatic coal spreaders, at left the water column mirrors and right, the superheater pressure gage



WATER INTO THE BOILER—Boiler feed pumps transfer pumps and piping ready for trial operation

Public Relations Audit Checks Customers' Attitude

Door-to-Door Survey by Two Men Covers 30,000 Customers Annually — Classification of Complaints Guides Policies

Don C. Ray
Manager Department of Public Relations, Pacific Gas & Electric Company

SHOULD you be one of the 600,000-odd customers of the Pacific Gas & Electric Company you could anticipate answering your doorbell some day to find a neat-appearing, courteous caller who would tactfully inquire whether you were satisfied with the gas and electric service rendered by your public utility company. He would encourage an expression of your frank opinion and lend an attentive ear to any complaints you might have. Considerate of your time, he would depart promptly, but very likely leave you in that pleasant mood which grows from the knowledge that "a big corporation" does seek out your opinion even to the extent of making an unsolicited, personal call.

Your caller would be one of the public relations auditors of the Pacific Gas & Electric Company. Behind his visit to your home is an efficient department of the company, the idea for which originated with Don C. Ray, manager of P. G. & E.'s bureau of public relations.

In relating his philosophy of public relations management Mr. Ray described in detail the operation of his interesting and unusual method of measuring the public's attitude and checking the quality of service as viewed by the consumer.

In a few succinct sentences Mr. Ray demonstrated the need for such a program by saying that accumulation and conservation of assets is a fundamental principle of good management. Every sound company keeps a close check on its physical property, such as inventories, accounts and all of the other tangibles which permit it to earn a profit. However, the most valuable asset of all, the good will of its customers, has defied evaluation in the strict sense that it can be measured as a finite quality. In a general way management knows whether public relations are good or bad, but these terms are purely relative and it is difficult both to measure the trend of public attiude and to uncover the specific reasons for trends one way or another.

It was to make good will less of an intangible and more of an index for guiding the establishment or revisions of policy that the Pacific Gas & Electric Company endeavored to evolve a plan which would provide an accurate sample or cross-section of its customers' attitude toward its service.

The plan

To be most effective, it was thought that such a plan should provide both a picture of conditions found from week to week and a method of tangible comparison of customer attitude over longer periods. The similarity of these objectives to those of modern accounting practice naturally directed the technique employed toward that used in accounting—that of providing current reports and annual balance sheets on customer good will. In short, the program essentially is a public relations audit.

Obviously, the only practical method of determining the customer's attitude toward the company and the service it renders is by personal interview. Furthermore, the interview must be of the type that will encourage outspokenness on the part of the customer so that a correct statement of his feelings will be obtained. As the territory service by the company covers 90,000 square miles, containing well over 600,000 meters, it can readily be seen that the sampling of customer opinion of the company and its policies in all localities and among all classes of customers is an undertaking of no small magnitude.

Auditors from general office staff

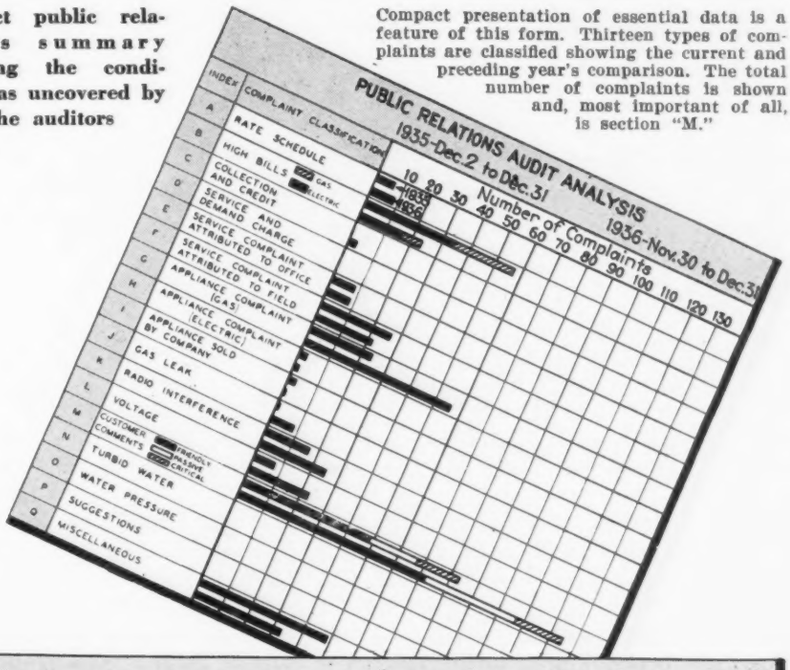
When the system was initiated two field public relations "auditors" were selected from the general office staff and started out in a given locality. These men were instructed to give a representative coverage of the territory, dividing their interviews approximately in proportion to the total number of customers in each classification in the teritory. It was found that these two men, working full time, could interview successfully 2,500 customers per month. For a year's work, this would be equivalent to 10 per cent of the total customers served, and it was felt that with the assumption that the reports were correct, this quantity would provide a reasonably accurate picture of the attitude of the whole group of customers. So far the re-

sults have justified this, so that it is not considered necessary to increase the field staff of auditors.

These two men are routed to cover all of the twelve divisions of the company in the course of a year, and in subsequent years they will be rerouted over the same territory, but not to the same customers, so that eventually practically all of the customers of the company will be interviewed at least once. The meterman's route book is used by the auditor as a guide. Thus every year the company will be provided with a 10 per cent sample of customer opinion in all of the divisions. As will be shown later, a rather surprising discrepancy of results is obtained between divisions which on being analyzed has uncovered local conditions needing remedial measures.

After each interview the auditor prepares in duplicate a report, a sample of which is illustrated herewith, describing the customer's attitude and setting forth in detail any complaint made. Complaints are classified in seventeen groups to expedite tabulation and comparisons. One of these reports is sent to the general office, where data are transferred to a master chart for that particular locality which shows the customers interviewed by classification, the attitude of each and the accumulated total of complaints in each classification. With this procedure, each division is checked annually, and when the auditors finish

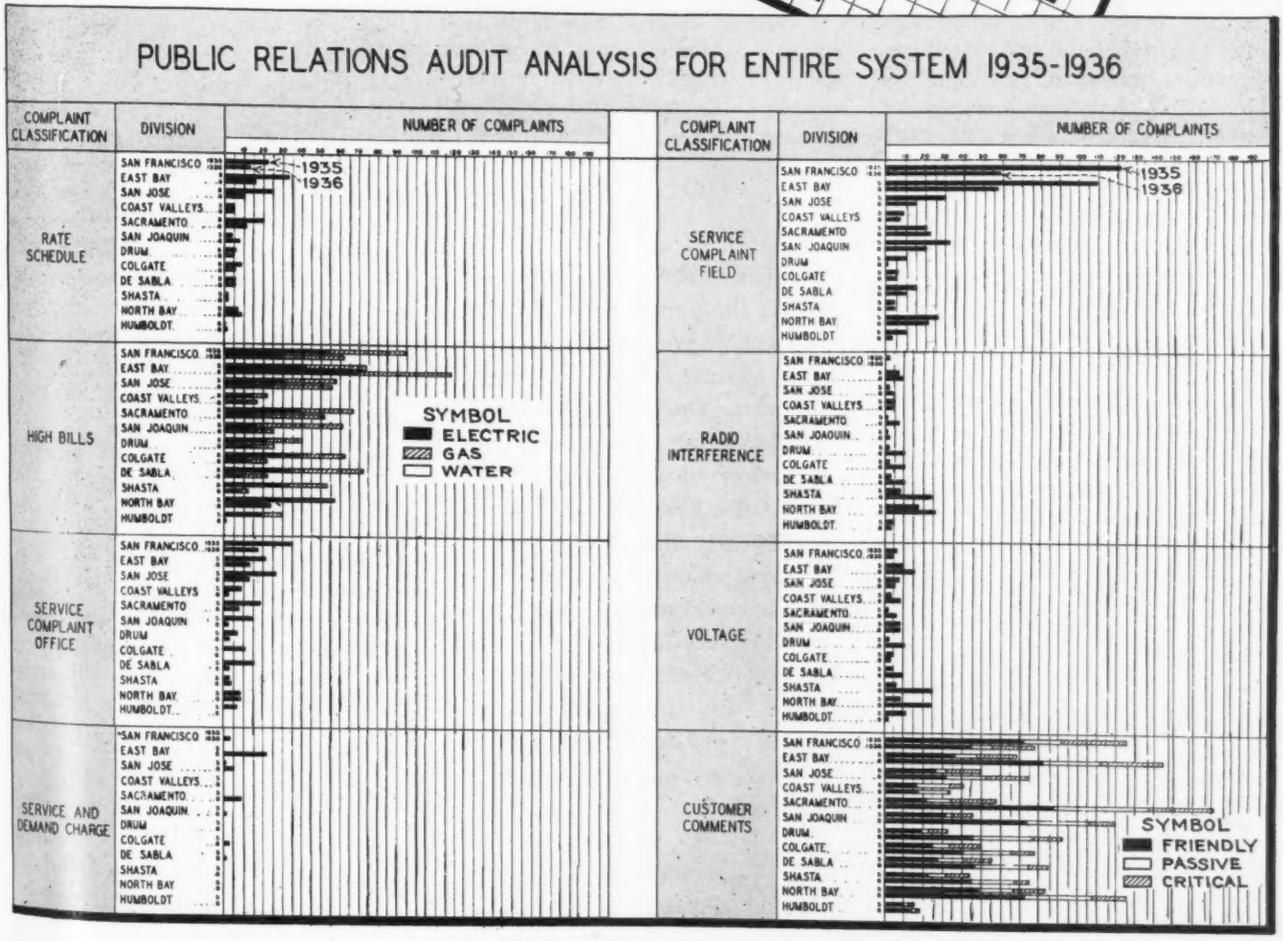
District public relations summary showing the conditions as uncovered by the auditors

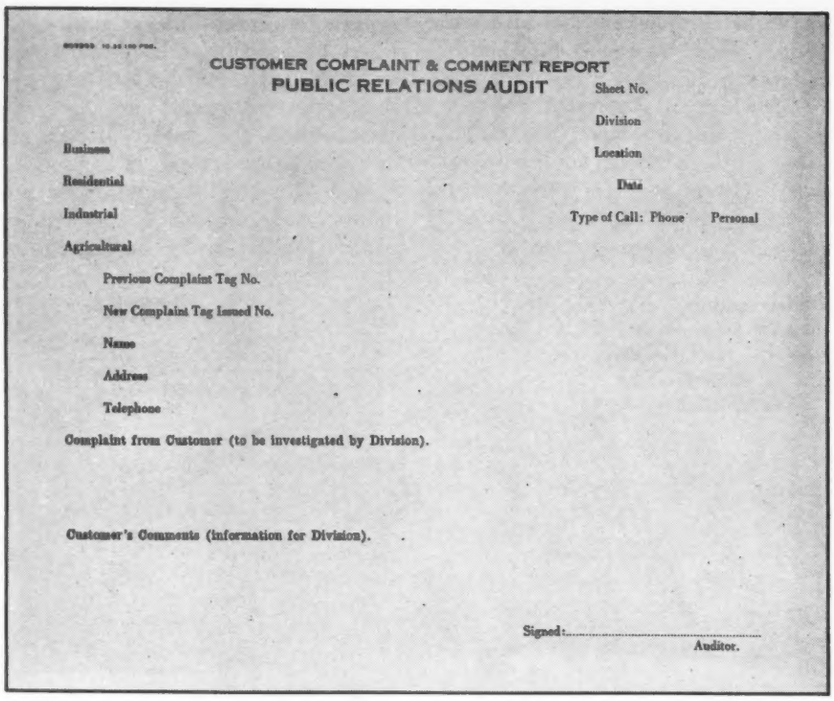


Compact presentation of essential data is a feature of this form. Thirteen types of complaints are classified showing the current and preceding year's comparison. The total number of complaints is shown and, most important of all, is section "M."

Public relations audit analysis for the entire system in which the division complaint sections are recapitulated for comparison

Again both the current and preceding year's findings are shown and the improvement in public attitude recorded. This form contains all of the sections listed in the form above, but is shown here in abbreviated form to conserve space. Including both 1935 and 1936 data, this form represents calls on 20 per cent of the 600,000 customers on the system—a very fair sample of customer opinion.





CUSTOMER COMPLAINT & COMMENT REPORT
PUBLIC RELATIONS AUDIT

Sheet No.
Division
Location
Date
Type of Call: Phone Personal

Business
Residential
Industrial
Agricultural

Previous Complaint Tag No.
New Complaint Tag Issued No.
Name
Address
Telephone

Complaint from Customer (to be investigated by Division).

Customer's Comments (information for Division).

Signed:.....
Auditor.

Complaint and comment report sheet issued in triplicate by the auditor and from which the division and general office follow-ups are made

interviews therein a complete chart of their findings in detail is available. Comparison of annual charts provides an accurate method of determining trends in public attitude as well as detecting service conditions through the detailed tabulation of complaints.

The open-handed and frank methods of the plan's operations preclude any thought of general office espionage. Rather, the division organizations welcome the auditors in their territories because they provide essential information not otherwise available which permits changes and adjustments for improved efficiency.

Technique employed

The essence of making a successful public relations audit is the interview with the customer. This, in turn, depends upon the caliber of the men selected and trained for field auditors. These men should be familiar with the company, its general policies, its history, rate schedules, billing and servicing as well as have a sound knowledge of the departmental functions and relationships. Furthermore, they must have an engaging personal appearance, which will encourage friendliness on the part of the customer, and they must like to meet the public. Men from the general office staff were selected primarily because it was felt that they should be strangers in each of the divisions, since should local men attempt interviews, personal friendships might color their accuracy.

One of the reasons why interviewing can be made successful is the fact that the field auditors have nothing to sell the prospect except friendliness and service. They have the prospect's name from the meter book and by explaining the purpose of their visit in the opening statement they gain entrance where other representatives fail. By their manner and expression they make it apparent at once that their call is purely a matter of mutual interest.

Once the purpose of the call has been impressed on the prospect a skilled interviewer can extract the information he needs, often without the customer knowing that he has given it. A rigid rule for the auditors is that the interview must not be a prolonged one. Here, again, the skilled man can detect when the interview should be ended, and this respect for the other man's time often has led to invitations to stay for further discussion, to call back or to have a specialist sent to discuss problems that have been bothering the customer.

Complaints double-checked

Primarily the interview is to determine the attitude of the customer; *i.e.*, whether friendly, neutral or critical. In specifically asking if service is satisfactory, request is also made for suggestions for improvements. The reaction of the customer is noted and the auditor, on his report, quotes as nearly as possible the customer's own words. This procedure has been found valuable as each customer's statement is later analyzed and classified. Where complaints are registered one copy of the report is sent to the local office of the company for immediate attention and this report, with the report of the service man responding to the call typed thereon, must be submitted promptly to the general office. This provides a double check on the complaint and insures that the customer feels that he is getting results from his request for service on the complaint. Very often the auditor himself can settle complaints on the spot. This is particularly true of high bill complaints because he has the meter book and can check both the readings and the customer's usage.

From his knowledge of the rate schedules and billing he often can point out the reason for additional consumption or that the customer is not being overcharged. In this connection the auditor carries a seasonal temperature chart which is valuable in explaining variations in billing due to seasonal consumption.

One of the first steps in the audit was the checking of the appliance maintenance work being done by the

[*Continued on page 122*]

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Six times since November 8, 1927, the people of San Francisco have gone to the polls to vote against bonds for power projects. During the first half of March the San Franciscans' rejection of the plan to acquire the electric distribution facilities of the Pacific Gas & Electric Company was the third rejection of municipal distribution plans in two weeks. For these reasons alone, this story of the door-to-door public relations audit of Pacific Gas & Electric is very timely and may illustrate some of the reasons why its customers seek no substitute for its services.

REA Lines

Objectives of REA

by

John M. Carmody

Rural Electrification Administrator

AS RECENTLY as 1935 rural line construction practices varied so widely that it was almost impossible to discover any significant common trends. The lines that were built were good lines; they were too good, in fact, and they were far too expensive. The business of building bridges capable of holding locomotives for the use of pedestrians is out of date. So is the practice of building rural lines that could support an automobile on every span.

Today basic standards have been widely adopted and the rural line—as distinguished from the urban line gone rural—has taken its rightful place as a member of society. The longer span, of course, is the most outstanding feature of these new rural lines. Many other factors enter in, however, such as standardized hardware and the elimination of the crossarm. The engineering for the lines is confined to the drafting-room. Materials and equipment have been simplified so that assembly-line methods of line construction can be used. There are few construction problems to be solved in the field.

REA did not invent these new rural standards. But it did assemble and co-ordinate the best modern practices and recommend them to the sponsors of its projects. I think REA can take a good deal of credit for the standardization which is coming in. I can say this with good grace because it all happened long before I was associated with this work.

In spite of the fact that standards have been improved and costs per mile cut materially, we must strive constantly for further improvement in both directions. We recognize this as a very real challenge, particularly in the face of a sharp rise in prices of practically all materials that enter into line construction. If this extends to appliances necessary to load building it may well become a serious menace to what now looks like the first real opportunity in this country to bring electricity to a large percentage of farmers throughout America.

As one means of offsetting these trends, we are going to see new methods of construction, new materials and new uses of well-known materials. Perhaps REA, either itself or through the project engineers scattered over the country, will hit upon some of these future improvements; perhaps they will come from utilities; perhaps from the manufacturers. It doesn't make any difference to us where these ideas come from. If they will show us how to get the same job done more rapidly, at lower cost, and without sacrificing essential strength or safety, we are going to adopt them and include them in our recommendations.

We have only one goal here. Keeping area coverage in mind, it is to take central station electricity to as many unserved American farms as we possibly can and to do this in the shortest possible time. Better and better line construction standards will go a long way toward realizing this objective.

Costs and Construction

Summary of Construction Practices on REA-Financed Lines, Both Completed and Under Construction, Together With the Unit Costs for Typical Projects

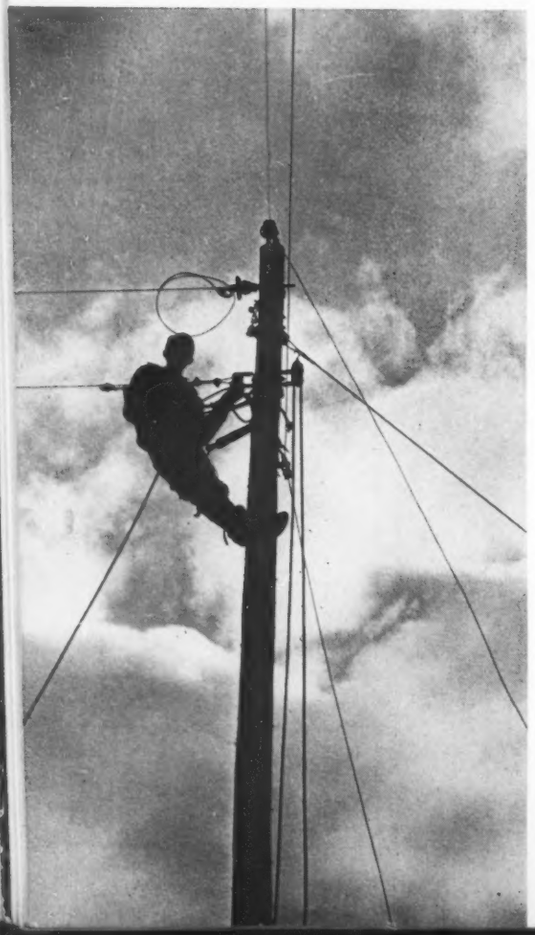
By M. O. SWANSON
Chief Engineer Rural Electrification Administration, Washington, D. C.

THE 86 projects which are used for the purpose of this discussion and the details of which are disclosed in the tabulation on page 62 are typical of those financed by the Rural Electrification Administration. These projects are distributed geographically as follows: Nine are located in the northwestern section of the United States, four are in the southwestern region, 53 are in the central northeast and twenty are in the southeastern portion of the country.

Engineers employed by the borrowers of each project are responsible for the actual layout and design of the distribution systems as dictated by field conditions and their respective engineering practices. Under the centralized guidance of the REA engineering division, a set of suggested practices is developing, modified for conditions as they appear in the field. Due to this interchange of ideas, costs of lines tend to approach similiarity for comparable conditions of terrain, right-of-way clearing and tree trimming, percentage of three-phase construction, consumer density and telephone interference.

Widely varying methods of construction are giving way to more uniform methods which lead to lower costs. Projects are constructed to the borrower's specifications by contract on a bid basis. The responsibility for proper construction rests with the borrower and his engineers. The REA engineering division makes a final inspection of the completed project before final payment, as well as intermittent inspections during construction.

A tap is being deadended at a 7,200-volt line



$280 per customer

Total cost of the projects tabulated herewith, ready for service, is estimated at more than $13,000,000, involving more than 13,500 miles of primary lines and serving 46,500 consumers. The weighted average cost per mile of line is $970 (or $280 per consumer) including overhead charges, tree trimming and clearing of right-of-way, pole inspection, meters and services. Obviously, this cost varies with the project characteristics, ranging from a minimum of $720 per mile to a maximum of $1,230 per mile (excluding one project serving several small rural communities, which is not typical of the REA-financed lines).

It is interesting to note that 160 miles is the average primary line mileage of these projects, with a maximum of 440 miles and a minimum of 12 miles. Of the indicated total of 13,000 miles, 30 per cent represents multiphase construction. An examination of the tabulation reveals the fact that rural line construction practice is breaking away from urban practice in that the majority of the systems employ 7.2/12.5-kv. wye networks, although fed from all types of systems (2.3 to 66 kv., one phase, three phase, wye and delta) through substations. In some cases, where the source of supply is distant from the project load center, substations are fed by transmission lines which are part of the project. Two types of substations occur most frequently, 3-150 kva. and 3-50 kva., although no trend is evident.

In several instances, in order to avoid unusually large conductors which would be necessary for adequate voltage regulation at the most distant consumer, step-type automatic voltage regulators are used on the lines. It has been found more desirable to place these regulators on the lines rather than at substations. However, large conductors (No. 2 to 1/0) are used as well where the borrower's engineer finds it more economical.

Most projects financed by the REA actually form the nucleus of future widespread rural distribution systems. It has, therefore, been the practice to anticipate future extensions, within reasonable and economical limitations, with provisions for future voltage regulating equipment, as well as for probable changes from single-phase to multi-phase construction.

In order to enhance the stability and safety of project lines, all primaries

Practices

and secondaries have common grounded neutrals. In the majority of cases these grounds are installed not only at all transformers, meters and ends of secondaries but also wherever distances between grounds exceed 2,000 ft.

Lightning protection of one form or another is specified by the engineers of all projects; the rare exceptions are for those localities where the hazard of lightning as indicated by records is negligible.

The lines designed by the borrower's engineer are Grade C construction generally, and up to the present experience with them indicates that under the worst loading conditions such construction is within ample margin of safety and consistent operation.

Built for 20-year life

At all times the ultimate factor in design and construction is to promote adequacy and sturdiness which will guarantee a minimum operating life of twenty years for the project, with not more than a reasonable amount of maintenance. In certain places copper conductor is used in conjunction with other types in order to reduce the cost of extensive three-phase construction. The tendency of design in distribution transformers is away from the rural type and toward the co-ordinated conventional type. For the greater part of these projects transformers are on 1½ kva. minimum capacity. The majority of meters are of the outdoor socket type, bought and installed by the borrower (not the contractor) and financed by the REA.

It is difficult to ascertain the trend in the cost per mile of line of REA-financed projects, due to the recent noticeable price increases of various units and materials, as well as rising labor scales and the difficulty in obtaining prompt deliveries from manufacturers, whose facilities are being taxed to the utmost by increased business activity. On the other hand, the desire of the project sponsors to make each dollar borrowed from the REA serve its purpose to the fullest extent is pressing engineers continually to seek ways for reducing further the cost of each mile of line. Their activity and their ingenuity, coupled with the co-operation of the manufacturers, cannot fail to result in rural lines of increasing efficiency and lower cost.

Gang sagging a 7.2/12.5-kv., three-phase line

Stump comes in handy in adjusting tension on a 7.2/12.5-kv. REA line

Earlier inserts in "Electrical World" (February 29 and August 15, 1936) surveyed the technic and costs of rural lines built by utility companies. Here we present data and supplementary statements of REA covering the projects financed by federal funds. In conjunction with the previous presentations, the industry thus has a comprehensive view of the progress made in the last three years in reaching unserved rural areas with progressively economical construction practices.

Construction Practices and

Projects	Electrical (a)						Mechanical								Design (d)						Estimated Cost per Mile	
	System		Location of Grounds (b, c)	Lightning Protection	Regulating Equipment (d)	% Miles of Multi-Phase to Single Phase	Primary			Conductor (e)		Poles (f)			Load per mile	Consumers per mile	Transformers				Line only	Total incl. overhead, meters and services, pole inspection
	Volts	Y or △					Average Span	Terrain	Tree Conditions	Kind	Sizes	Kind	Classes	Heights			Min. Size	Type	Substation No.	Substation Sizes		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	7.2/12.5	Y	TL	T	N	33.50	300	R	M	ACSR	6-2	SYP	16-4	65-30	3.4	3.4	1.5	SP	....	....	$939.89	$1,082.10
																			1	100		
2	6.9	Y	TSL	T	PA	0.00	550	H	H	ACSR	4-2	SYP	6	100-30	3.9	4.6	1.5	CP	1	37.5	844.16	941.12
3	7.2/12.5	Y	TL	T	N	32.50	325	R	H	Cwld	6-2	SYP	6-4	60-30	4.7	3.8	1.5	C	....	....	905.43	994.11
4	13.2/6.9	△△	TS	N	N	0.00	300	H	M	Cu	6-8	WRC	6-4	60-30	4.3	5.6	1.5	C	1	37.5	927.03	1,035.92
5	6.9	Y	TL	T	N	0.00	490	R	M	ACSR	6-2	SYP	6-3	50-30	3.9	4.6	1.5	C	....	....	727.27	830.51
6	7.2/12.5	Y	TL	T	N	17.10	300	R	M	ACSR	6-4	SYP	6-4	60-30	3.3	3.3	1.5	C	....	....	837.15	913.60
7	7.2/12.5	Y	TL	T	N	32.50	325	R	H	Cwld	6-2	SYP	6-4	60-30	4.7	3.8	1.5	C	....	....	905.43	994.11
8	7.2/12.5	Y	TSL	TA	N	47.00	305	R	M	ACSR	6-1/0	WRC	6-4	60-30	3.0	3.0	1.5	C	3	150	823.44	917.45
9	7.2/12.5	Y	TL	T	N	31.00	305	F	M	Cwld, Cu	8-2	WRC	6-4	50-30	3.0	3.0	1.0	R	....	....	968.30	1,077.27
10	7.2/12.5	Y	TL	T	N	78.00	295	H	M	ACSR	6-2	SYP	6-4	50-30	3.1	3.6	1.5	C	....	....	885.00	987.87
																			1-50	1-25		
11	6.9	Y	TSL	T	N	0.00	310	F	L	Cwld, Cu	6-4	SYP	6-4	50-30	3.75	3.75	1.5	R	1-75	1-100	.....	937.50
12	7.2/12.5	Y	TSL	T	N	37.00	300	.....	.....	Cwld	10-2	SYP	6-4	60-30	4.0	4.0	1.0	R	3	150	1,075.58	1,173.76
13	7.2/12.5	Y	TS	TA	PA	10.00	280	H	H	Cwld	8-4	SYP	6-3	45-30	3.04	3.7	1.5	C	3	50	817.78	897.15
14	7.2/12.5	Y	T	A	PA	23.00	330	H	H	ACSR	4-1/0	SYP	6-3	45-30	3.3	3.3	1.5	C	3	100	855.21	946.56
15	7.2/12.5	Y	TL	T	N	28.20	330	F	M	Cwld	6-2	WRC	6-4	50-30	2.6	2.6	1.0	R	....	....	930.39	1,004.00
16	7.2/12.5	Y	TSL	T	N	30.00	285	R	M	ACSR	6-2	WRC	6-4	60-30	2.75	3.0	1.0	R	3	25	879.19	977.37
17	6.9	△	TS	T	N	2.90	295	F	M	ACSR	6	SYP	6-4	60-30	3.0	3.0	1.5	C	3	25	949.88	1,019.75
18	7.2/12.5	Y	TL	TA	N	9.10	295	R	M	ACSR	8-2	WRC	6-3	50-30	2.5	2.7	1.0	R	....	....	897.40	971.04
19	7.2/12.5	Y	TL	T	N	95.00	310	F	M	ACSR	6-2	SYP	6-4	65-30	4.0	3.5	1.5	SP	....	....	1,037.74	1,168.02
20	7.2/12.5	Y	TL	T	N	16.8	355	R	M	Cwld	6-4	SYP	6-4	60-30	3.2	3.2	1.5	C	....	....	804.50	978.22
21	7.2/12.5	Y	TL	T	N	0.00	400	R	M	ACSR	6-2	SYP	6-3	50-30	3.7	4.4	1.5	C	....	....	731.76	814.71
22	7.2/12.5	Y	TL	T	N	0.00	250	H	M	Cu	6-2	SYP	6-4	50-30	3.4	4.0	1.5	C	....	....	772.82	856.19
23	7.2/12.5	Y	TL	T	N	17.90	350	R	M	Cwld	6-2	SYP	6-4	60-30	3.1	3.1	1.5	SP	....	....	886.95	972.00
24	7.2/12.5	Y	TSL	T	N	9.20	335	F	M	Cwld	6-4	SYP	6-3	50-30	3.2	2.75	1.5	SP	3	25	832.46	905.94
												L.P.							6	25		
25	6.9	△	TS	T	N	14.80	285	F	L	ACSR	6-4	WRC	6-3	50-30	2.4	2.7	1.5	CP	3	37.5	945.54	1,014.92
26	7.2/12.5	Y	TL	T	N	47.50	400	H	M	Cwld, Cu	8-2	SYP	6-2	65-30	3.2	3.4	1.0	R&C	....	....	938.52	1,080.04
27	7.2	△	TS	T	N	200.00	240	R	H	ACSR	8-2	SYP	6-4	60-30	9.0	11.8	3.0	C	....	....	1,186.32	1,381.60
28	6.9/12	Y	TSL	T	N	51.00	490	H	M	ACSR	6-2	SYP	6-3	70-30	4.0	4.6	1.5	C	3	75	812.43	934.12
29	7.2/12.5	Y	TL	T	N	19.50	305	R	M	ACSR	6-4	SYP	6-2	60-30	3.0	3.0	1.0	SP	....	....	849.08	945.22
30	7.2/12.5	Y	TL	TA	N	37.00	345	H	H	Cwld	6	WRC	6-4	45-30	3.0	3.4	1.0	R	....	....	1,014.24	1,100.99
31	7.2/12.5	Y	TSL	T	N	33.00	300	H	L	Cwld, Cu	6-2	SYP	6-3	50-30	3.1	3.1	1.5	C	3	100	762.50	836.46
32	7.2/12.5	Y	TSL	T	N	30.00	335	F	M	Cwld	6-2	SYP	6-4	60-30	2.3	2.6	1.0	R	3	100	1,070.51	1,215.37
33	6.9/12	Y	TSL	T	N	13.50	335	F	L	ACSR	6-2	SYP	6	50-30	2.6	3.0	1.0	R	3	25	731.05	784.31
34	7.2/12.5	Y	TSL	T	N	34.00	330	R	L	Cwld	8-6	SYP	6-2	60-30	3.7	3.7	1.0	R&C	6	100	832.36	913.27
35	6.9	△	TL	T	N	0.00	300	F	L	ACSR	4	SYP	6	40-30	2.9	3.8	1.5	C	....	....	954.49	1,069.86
36	6.9	Y	TL	T	N	0.00	310	R	L	ACSR	8-2	SYP	7-4	50-30	6.5	7.0	3.0	R	....	....	876.74	966.61
37	6.9/12	Y	TL	T	N	52.00	315	H	H	ACSR, Cu	6-4	SYP	6-3	45-30	2.5	2.75	1.0	R&C	....	....	750.66	820.02
38	6.9	Y	TL	T	N	0.00	390	R	M	ACSR	6-2	SYP	9-3	50-30	3.8	3.9	1.5	C	....	....	752.59	899.45
39	7.2/12.5	Y	TL	T	N	13.40	325	R	M	Cwld	6-4	SYP	6-4	60-30	3.7	3.0	1.5	C	....	....	867.53	1,008.76
40	6.9/12	Y	TSL	T	N	47.00	380	F	L	ACSR	6-2	SYP	7-5	50-30	2.5	3.0	1.5	C	3	150	696.23	795.51
41	7.2/12.5	Y	TSL	TA	N	119.00	290	R	M	ACSR	8-2	WRC	6	50-30	2.7	2.9	1.0	R	3	50	1,116.57	1,231.16
42	7.2/12.5	Y	TL	T	N	25.00	295	R	M	ACSR	6-4	SYP	6-4	50-30	2.5	2.5	1.0	C	....	....	796.33	858.31
43	6.9	△	TS	T	N	22.00	300	F	L	ACSR	6	WRC	9-4	50-30	2.6	3.3	1.5	CP	2	25	1,055.63	1,070.88
44	7.2/12.5	Y	TSL	T	N	4.30	300	F	M	Cwld	6-4	SYP	6-4	50-30	4.3	4.3	1.5	R	1	300	857.86	990.26
45	7.2/12.5	Y	TS	A	PA	28.00	325	H	M	Cwld	6-4	SYP	6-3	45-30	3.0	3.3	1.5	C	3	50	901.71	1,012.60
46	7.2/12.5	Y	TL	TA	N	190.00	400	H	L	ACSR	4-2	SYP	6	55-30	3.7	6.5	3.0	C&R	....	....	1,097.26	1,207.01
47	4.6/ 8.0	Y	TSL	T	N	11.00	350	F	L	Cwld	6	SYP	7-5	45-30	3.3	3.3	1.0	R&C	3	25	684.59	719.57
48	7.2/12.5	Y	TSL	T	N	12.60	300	R	L	Cwld	6-2	SYP	6-4	50-30	2.5	2.5	1.0	R&C	3	150	705.67	786.50
49	7.2/12.5	Y	TL	T	N	12.90	350	H	L	Cwld	8-2	SYP	6-4	45-30	4.8	4.9	1.0	R&C	....	....	891.25	986.91
50	6.9/12	Y	TSL	TA	N	3.90	290	R	M	ACSR	6-8	WRC	6	40-30	2.0	2.2	1.0	R	3	25	666.00	748.00
51	7.2/12.5	Y	TSL	T	N	33.30	240	H	M	Cu	6-4	SYP	6	40-30	3.5	4.1	1.5	C	3	37.5	.....	1,000.00
52	7.2/12.5	Y	TSL	T	N	26.40	390	M	H	Cwld	8-4	SYP	6-4	55-30	2.5	2.8	1.5	C	1	150	799.60	944.19
53	7.2/12.5	Y	TL	T	N	31.50	310	F	M	Cwld	8-2	WRC	6-4	50-30	3.0	3.0	1.0	R	....	....	1,011.08	1,093.17
54	33.0 / 6.9/12	△ Y	TL	T	N	101.00	330	R	M	Cwld, Cu	8-1/0	SYP / WRC	6-2	60-30	1.5	1.5	1.5	R	....	....	1,110.20	1,182.64
55	6.9 / 6.9	△ Y	TSL	TA	N	0.00	250	R	H	Cwld	6	WRC	6	35-30	3.0	3.0	1.0	R&CF	1	50	851.00	925.23
56	7.2/12.5	Y	TS	A	PA	21.00	335	F	M	ACSR	6-1/0	SYP	6-4	45-30	2.9	2.9	1.5	C	3	100	744.00	833.00
57	7.2/12.5	Y	TSL	T	BA	21.00	330	F	M	Cwld	6-4	WRC	6-5	65-30	3.0	4.85	1.5	C	3	100	921.00	1,042.84
58	7.2/12.5	Y	TSL	T	Y	36.00	300	F	M	Cwld	6-2	SYP	6-4	45-30	4.2	4.7	1.0	R	3	100	908.68	1,003.16
59	7.2/12.5	Y	TL	T	N	85.00	330	M	H	ACSR	4-2	SYP	6-3	50-30	4.0	4.2	1.0	R&C	....	....	901.84	1,048.51
60	7.2/12.5	Y	TS	A	PA	22.00	330	R	H	Cwld	6-1/0	SYP	6-3	60-30	3.0	3.0	1.5	C	3	200	790.00	885.00
61	6.9	Y	TL	T	N	0.00	250	H	L	Cwld	8-6	SYP	6	45-30	1.8	7.0	1.0	R&C	....	....	973.47	1,126.17
62	6.9/12	Y	TSL	T	N	41.50	300	F	M	ACSR	6-4	SYP	6-4	45-30	3.1	3.3	1.5	C	3	50	809.74	915.72
63	6.9/12	Y	TSL	T	N	88.00	310	H	H	Cwld	6-1/0	SYP	6	40-30	3.1	3.6	1.0	R&C	3	150	.....	1,239.94
																			1	300		
64	7.2/12.5	Y	TSL	T	N	71.50	520	H	L	Cwld,Cu	8-2	SYP	6-3	60-30	2.5	2.8	1.5	C	1	150	895.56	1,047.24
65	7.2/12.5	Y	TL	T	N	22.00	315	F	M	ACSR	6-2/0	SYP	6-3	50-30	3.3	3.3	1.0	R	....	....	699.71	759.54
66	6.9	Y	TSL	T	N	0.00	400	R	L	ACSR	6	SYP	6	40-30	3.5	3.6	1.5	C	Insul Trns	37.5	740.81	859.44
67	13.2	△	TS	N	N	0.00	300	H	M	ACSR	6-4	WRC	6-4	55-30	4.0	4.5	1.0	R	1	37.5	829.75	990.00
68	7.2/12.5	Y	TSL	T	N	16.30	300	F	M	ACSR	6-4	SYP	5-4	60-30	2.4	2.7	1.5	SP	3	15	901.35	929.35
69	7.2/12.5	Y	TSL	TA	N	7.70	350	H	M	Cwld	6-4	WRC	6-4	50-30	4.5	5.0	1.0	R	3	50	760.70	827.08
70	7.2/12.5	Y	TL	T	N	30.00	310	R	M	ACSR	6-4	SYP	6-4	60-30	3.7	3.7	1.0	R	3	50	840.41	925.41
71	6.9	△	T	T	N	59.00	200	H	M	Cu	6-2	SYP	6-4	50-30	1.5	5.8	1.5	C	....	....	1,349.09	1,520.27
72	6.9/12	Y	TSL	T	N	66.60	350	F	L	ACSR	4-2	SYP	6-4	60-30	2.6	3.0	1.0	R	3	25	952.38	1,000.00
73	6.9/12	Y	TSL	T	N	12.50	305	F	L	ACSR	6-2	SYP	9-3	50-30	2.2	2.4	1.5	C	3	150	814.66	871.69
74	7.2/12.5	Y	TSL	T	N	15.70	320	R	M	Cwld	8-1/0	SYP	6-4	60-30	3.3	3.3	1.0	R	3	150	1,029.14	1,115.09
75	7.2/12.5	Y	TSL	TA	N	2.20	315	F	M	ACSR	6-4	SYP	6-4	50-30	3.6	3.2	1.0	R	3	50	705.90	809.44

Costs of REA Rural Lines

Projects	Electrical (a)						Mechanical								Design (d)						Estimated Cost per Mile	
	System		Location of Grounds (b, c)	Lightning Protection	Regulating Equipment (d)	% Miles of Multi-Phase to Single Phase	Primary			Conductor (e)		Poles (f)			Load per mile	Consumers per mile	Transformers				Line only	Total incl overhead, meters and services, pole inspection
	Volts	Y or △					Average Span	Terrain	Tree Conditions	Kind	Sizes	Kind	Classes	Heights			Min. Size	Type	Substation No.	Substation Sizes		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
76	6.9	Y	TSL	T	N	64.00	330	H	M	ACSR	6-1/0	SYP	6-5	65-30	3.8	5.4	1.5	C	3	150	$1,128.60	$1,340.18
77	7.2/12.5	Y	TSL	T	N	14.00	325	R	M	Cwld	8-4	SYP	6-4	60-30	3.1	3.1	1.0	R	3	100	914.37	1,051.44
78	7.2/12.5	Y	TSL	T	N	10.00	300	R	M	Cwld	8-4	SYP	6-4	60-30	4.4	4.4	1.0	R	3	150	930.53	1,025.80
79	6.9/12	Y	TSL	T	N	4.10	275	R	M	Cu	6-4	SYP	7-5	50-30	4.5	5.6	1.5	C	3	50	782.43	873.43
80	7.2/12.5	Y	TL	T	N	14.00	310	R	M	ACSR	6-4	SYP	6-4	60-30	5.4	2.7	1.5	R	....	....	738.38	805.93
81	7.2/12.5	Y	TS	T	N	15.80	275	R	M	Cwld	6-2	SYP	6-4	60-30	4.4	4.4	1.0	R	....	....	925.00	1,021.27
82	6.9/12	Y	TL	T	N	17.00	330	R	L	Cwld	8-1/0	SYP	6-4	45-30	3.8	3.8	1.0	R	....	....	903.45	989.01
83	6.9/12	Y	TSL	T	N	18.30	300	R	M	ACSR	6-2	SYP	6-4	50-30	2.7	3.0	1.0	R	3 3	150 50	900.48	978.88
84	7.2/12.5	Y	TSL	T	N	8.70	300	R	M	ACSR	8-2	SYP	6-4	60-30	3.3	3.3	1.0	R	3	75	768.09	892.86
85	7.2/12.5	Y	TSL	T	N	22.40	370	H	L	Cwld, Cu	8-2	SYP	6-2	60-30	2.5	2.8	1.5	C	2 1-15 5-25	150 1-75 3-100	803.65 818.10	947.35 1,117.02
86	7.3	△	TS	TA	N	11.00	250	R	M	Cu	8-4	SYP	7-4	45-30	3.3	5.1	1.5	CP				

Explanation of Column Headings

(a) All Y-connected lines have common neutrals.

(b) The resistance of grounds in all cases complies with code specifications.

(c) In Y-connected lines the grounds are connected to the common neutral.

(d) The suggested maximum over-all voltage regulation is 10 per cent.

(e) The line loading in all cases complies with N.E.S.C. requirements.

(f) All Southern yellow pine poles are given full-length pressure treatment, all Western red cedar poles are butt treated.

Explanation of Symbols Used in Columns

Column 3. *Location of Grounds*—T at transformers. S at substations. L along the line, at various intervals.

Column 4. *Lightning Protection*—With two exceptions (in territory where the occurence of lightning is negligible) all lines are supplied with some type of protection. T indicates gaps, oil circuit breakers. A indicates additional protection wherever advisable.

Column 5. *Regulating Equipment*—As indicated in Note (d), the suggested maximum over-all voltage regulation is 10 per cent. PA refers to pole type automatic voltage regulators. BA refers to bus type automatic voltage regulators. N refers to no regulating equipment.

Column 6. *Per Cent Miles of Multi-phase to Single-phase*—The number of miles of multi-phase line in a project obviously affects the overall per mile cost. Higher percentages will occur, in most cases, with greater per mile costs.

Column 7. *Average Span*—These values are derived from design specifications and may vary slightly in the field, depending upon the character of the line right of way.

Column 8. *Terrain*—The characteristics of the terrain affect the construction characteristics of the line. F refers to flat terrain. R refers to rolling terrain. H refers to hilly terrain. M refers to mountainous terrain.

Column 9. *Tree Conditions*—L refers to light tree density at line's right-of-way. M refers to medium tree density at line's right-of-way. H refers to high tree density at line's right-of-way.

Columns 10 and 11. *Conductor Kind and Sizes*—A.C.S.R. refers to an aluminum cable steel reinforced. Cwld refers to copperweld-copper conductors. Cu refers to hard-drawn copper conductor. The sizes indicated are for maximum and minimum copper equivalent classifications.

Columns 12, 13 and 14. *Poles—Kind, Classes and Heights*—S.Y.P. refers to Southern yellow pine poles, full length treated. W.R.C. refers to Western red cedar poles, butt treated. The classes and heights refer to maximum and minimum A.S.A. classifications.

Column 15. *Load per Mile*—This is calculated on the basis of estimated consumer consumption.

Column 18. *Type of Transformers*—C refers to conventional type. CP refers to completely self-protected type. SP refers to conventional types, equipped with lightning protectors. R refers to rural type.

Columns 20 and 21. *Estimated Costs per Mile*—Column 21 is greater in amounts than Column 20 in that such costs as meters and services, overhead, pole inspection are included.

Supplementary Details for Specific Projects

These remarks refer to such features of each project which have a direct bearing upon its cost. Telephone work refers to construction required on telephone lines to correct inductive interference or to remove structural conflicts.

2. The tall poles were for a navigable river crossing.

4. Considerable telephone work.

8, 16, 26, 28, 32, 38, 40, 44, 57, 59, 64, 66, 68, 73, 75, 76, 77, 84, 85. Telephone work.

12, 63. Considerable three-phase to feed other projects.

13, 31, 55, Winding roads.

15. Metering station included.

19. Considerable three-phase to feed future project.

27. Distribution system for several small rural communities.

30, 33. Changes of one-phase to three-phase line.

41, 46. Considerable three-phase line.

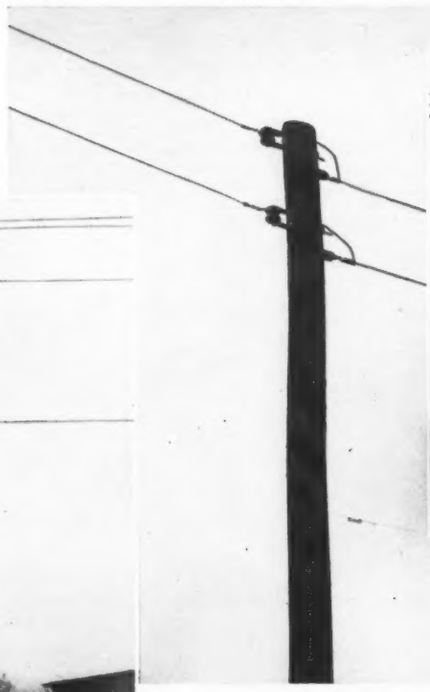
52. Mountainous, telephone work.

54. Includes considerable three-phase and 33-kw. line.

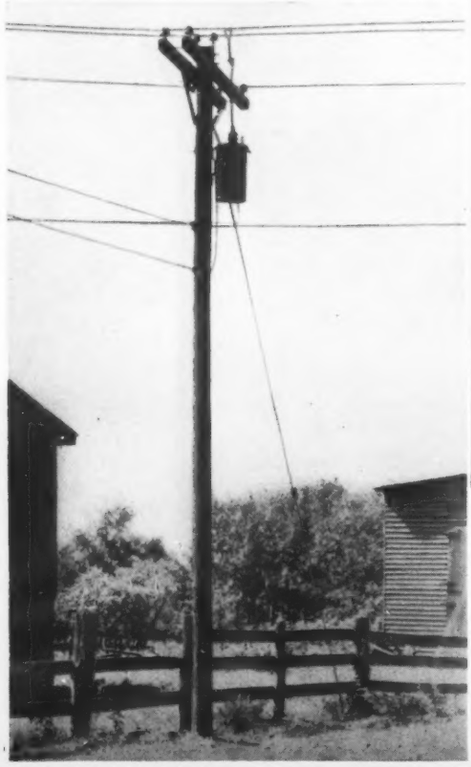
67. Rocky ground, telephone work.

71. Rocky ground, small project.

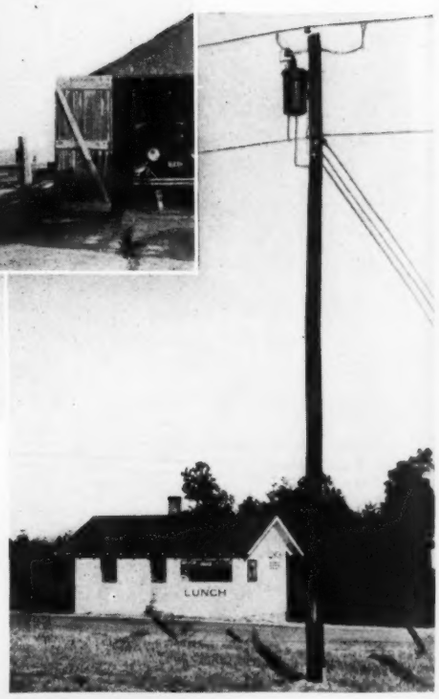
Construction in progress on three-phase primary, transformer protected with lightning gap



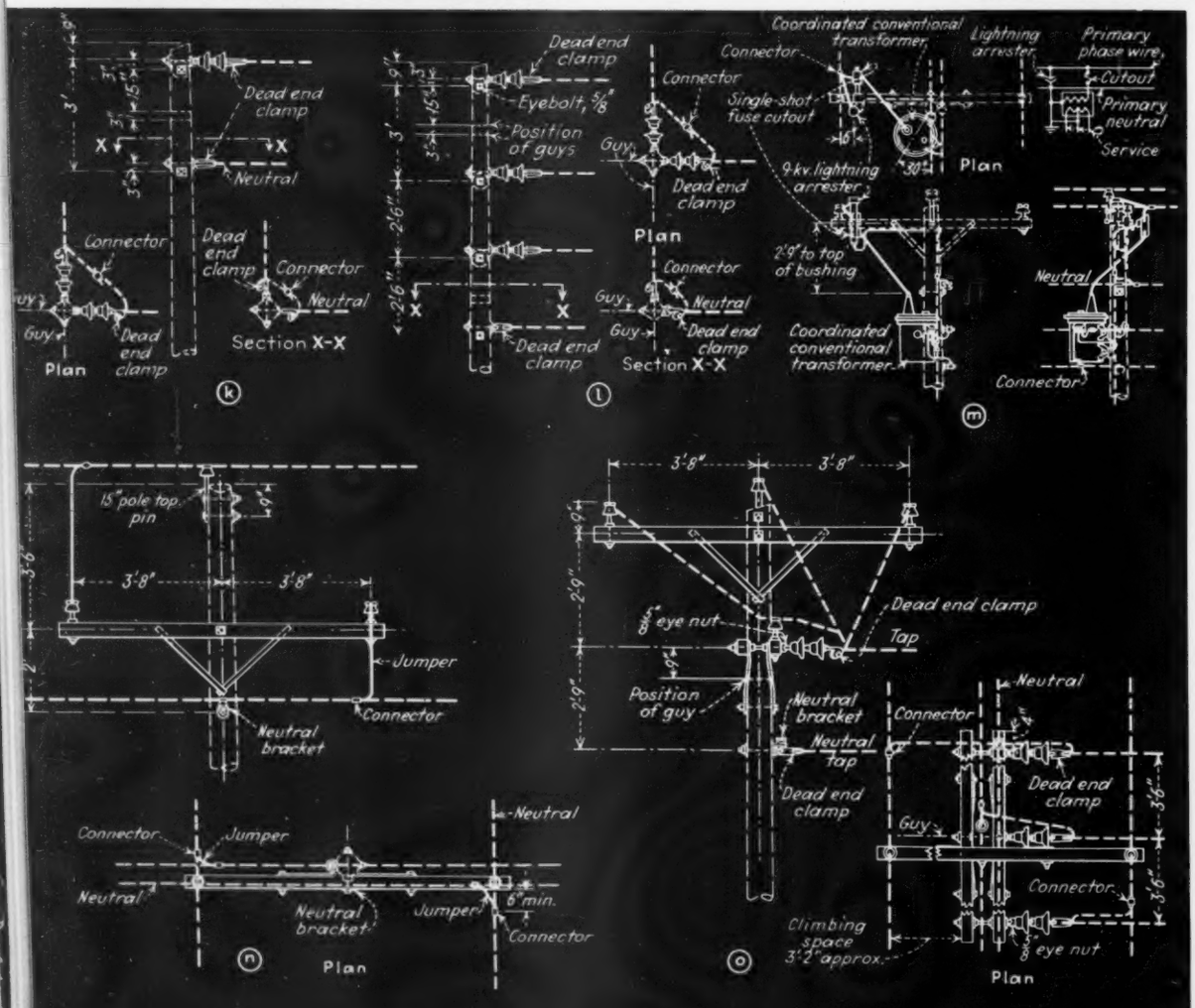
Vertical construction at a service pole



Secondary deadended at service pole



Lightning protective gap used with rural type transformer on 7.2-kv., single-phase line



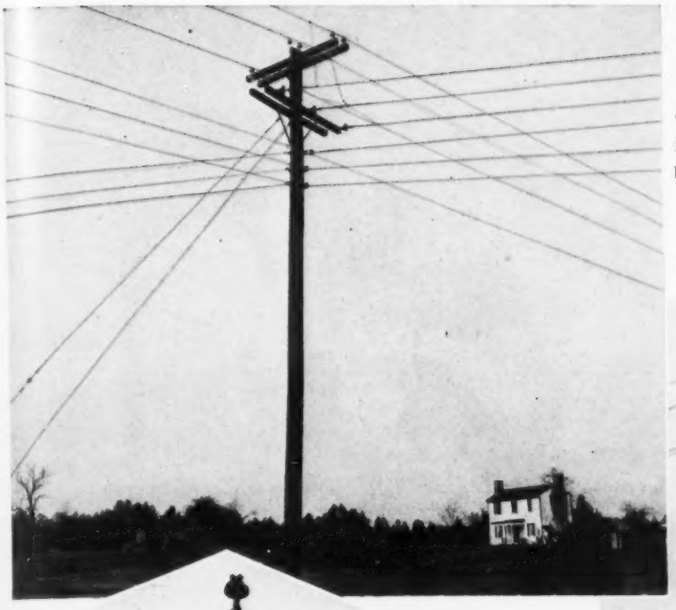
(k) Single-phase primary makes 60-90 deg. turn. Grounded neutral with vertical construction

(l) Jumpered offset turns primary through 60-90 deg. angle

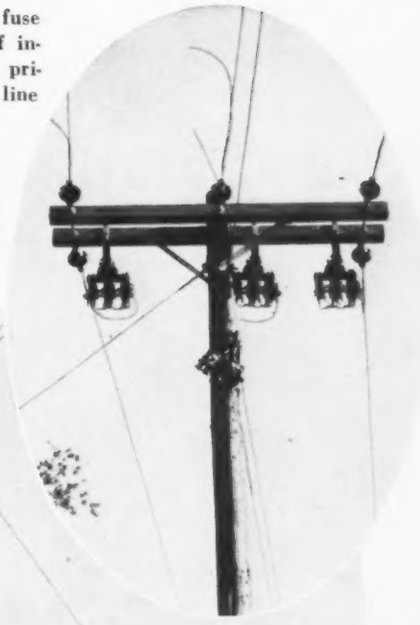
(m) Transformer on pole with arrester and cutout on crossarm. Three-phase, four-wire star with grounded neutral

(n) Single-phase vertical tap from flat single-phase primary

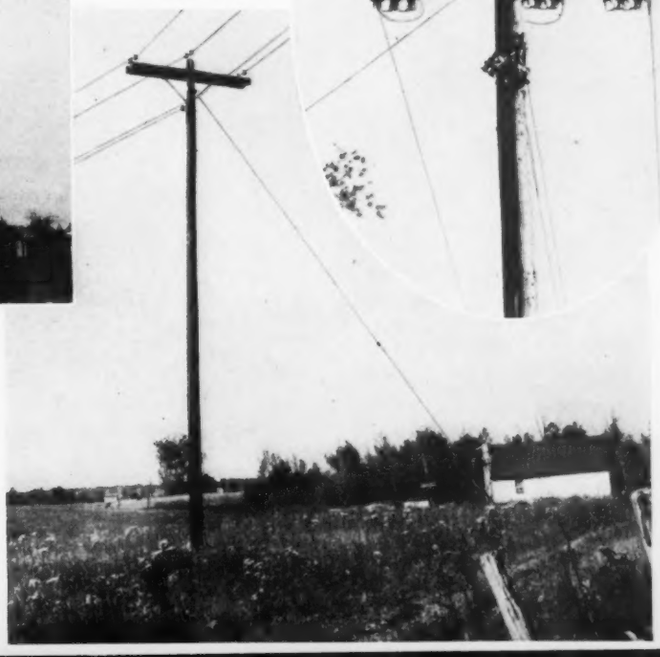
(o) Deadended three-phase tap from three-phase run. Four-wire star with neutral in lower position



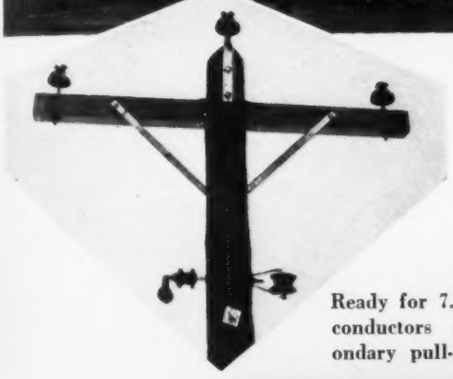
Triple-shot repeater fuse cutouts in process of installation on REA primary line



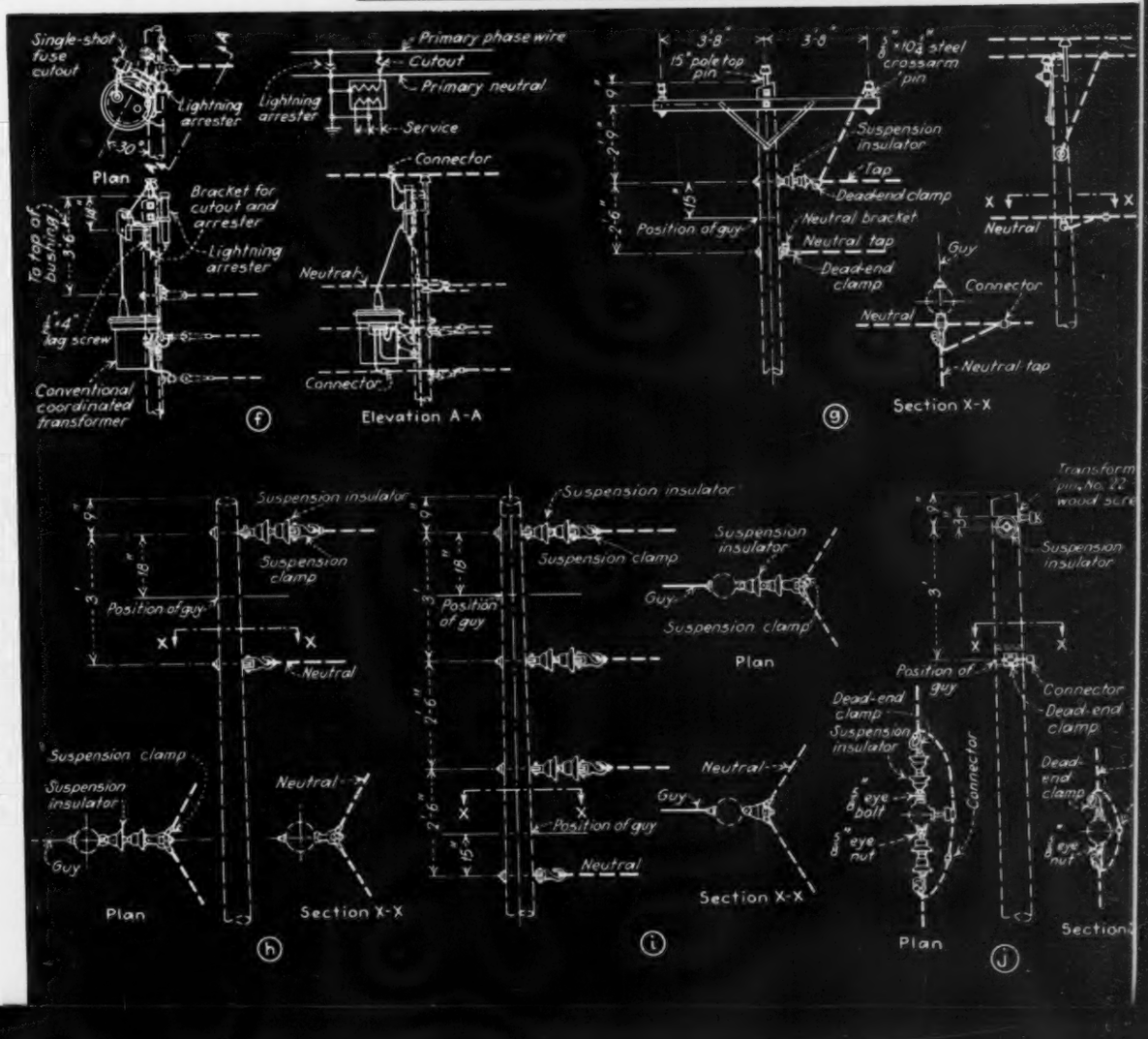
Crossarms doubled in making three-phase tap



Turning a 10-30 deg. angle on flat primary construction



Ready for 7.2/12.5-kv. conductors and secondary pull-offs



(f) Transformer mounting adapted to vertical construction. Grounded neutral; arrester and fused primary cutout used

(g) Vertical single-phase tap off four-wire primary horizontal

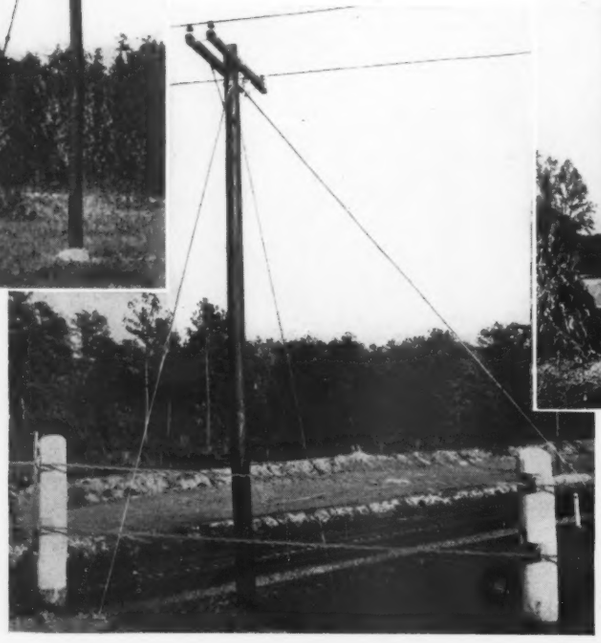
(h) Suspension clamp affords 30 to 60 deg. angle. Grounded neutral line has double insulation in ungrounded leg

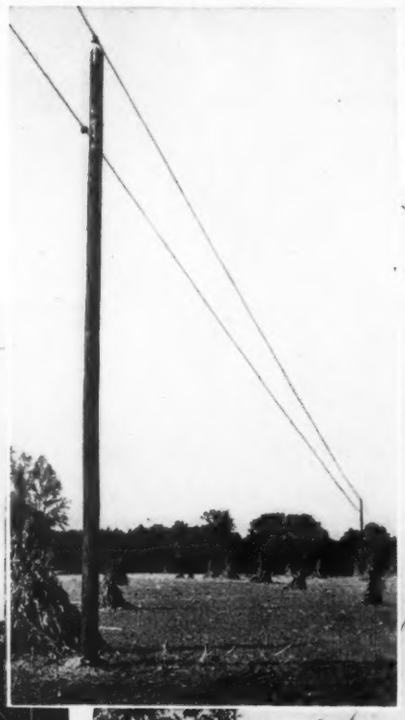
(i) Angles of 30-60 deg. turned with vertical construction

(j) Double dead-end for vertical single-phase primary neutral grounded

Angle of 10-30 deg. turned with doubled pole top pins and suspension arrangement of grounded neutral

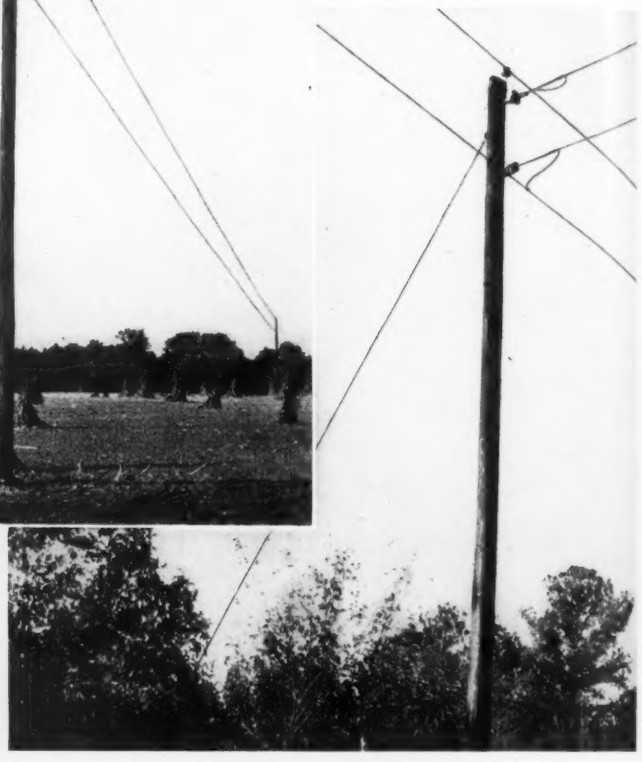
Railroad crossing effected with double arms and triple guying

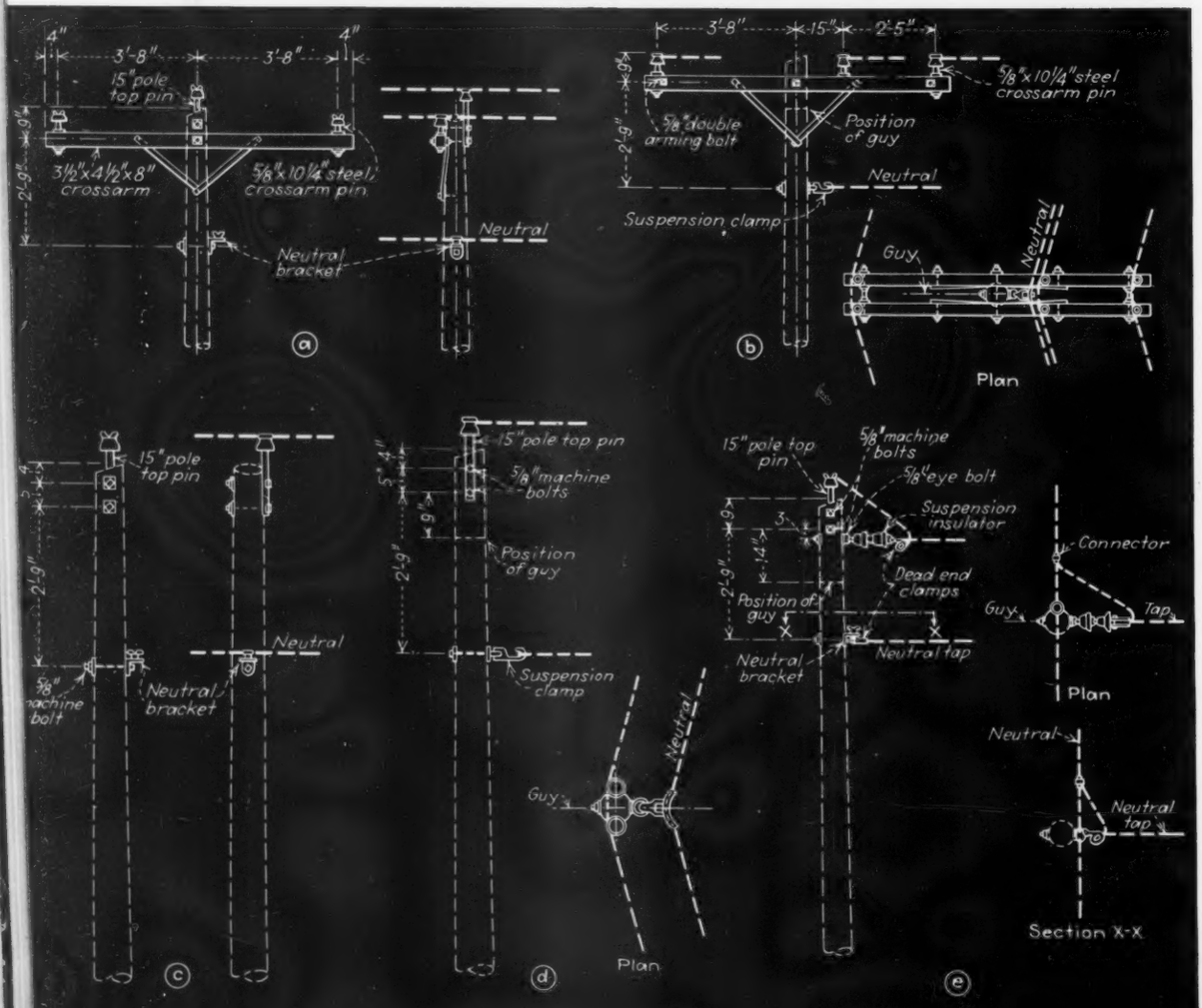




Simplicity marks vertical construction of 7,200-volt REA line

Tap from 7.2-kv. line founded on deadend





(a) Construction suggested for three-phase, four-wire star. Crossarm design permits angles up to 10 deg.

(b) Turning a primary angle with four-wire star REA suggested specifications for angles 10 to 30 deg.

(c) REA suggests this construction for single-phase primary. Two-wire, neutral grounded, for tangents and angles to 10 deg.

(d) On angles double-pole top pins are suggested by REA. Single-phase primary, neutral grounded on 10 to 30 deg. angles

(e) Tap made from single-phase primary. Vertical construction with neutral grounded

Simplifies Calculation for Tapered Poles

By R. C. BARTON
Pacific Telephone & Telegraph Company

Deflections and Slopes at Any Point Expressed in Percentage of Maximum Values at Load Point

TO SIMPLIFY calculation of pole deflections in cases where accuracy demands recognition of taper it is convenient to use a series of conversion factors. They are applied to the slopes and to the deflections computed on the assumption that the pole is not tapered. The factors, which are applicable only to the point of maximum slope and deflection—that is, the point where load is applied—are expressed in per cent.

Cross-sectional dimensions of the pole at the ground line are used in making the first calculation. The pole is regarded as a cantilever beam, so disposed that its own weight can be neglected, carrying a concentrated load. The ordinary elastic curve equations are used. These are:

$$\text{Maximum slope} = \frac{PL^2}{2EI} = N$$

$$\text{Maximum deflection} = \frac{PL^3}{3EI} = \frac{LN}{1.5} = Q$$

Where:

P = load
L = distance from ground to load
E = modulus of elasticity
I = moment of inertia

To express taper mathematically, a dimension ratio r is used. This represents the ratio of linear sectional dimensions of the pole at the ground line and at the point of load.

The dimension ratio r may be determined from a quantity called the taper factor R. R is of such magnitude that RL is the maximum possible beam length at the given taper rate; that is to say, the cross-section would vanish if the beam were extended a distance L $(R—1)$. The relation between the taper factor R and dimension ratio r is:

$$r = \frac{R}{R—1}$$

These relationships are shown in the illustration on page 68.

There are five ways in which the cross-section of the pole may vary. These are classified as the following cases:

(A) Any uniform cross-section.
(B) Rectangular cross-section of constant depth and variable width.
(C) Rectangular cross-section of constant width and variable depth.
(D) Any cross-section having a single vanishing point (includes natural round poles).
(E) Rectangular cross-section of variable width and variable depth (a general case

SLOPE m at x DISTANCE FROM LOAD

Case A $$N\left[1-\left(\frac{X}{L}\right)^2\right]$$

Case B $$N\left[1-\frac{X}{L}-(R-1)\cdot\ln\frac{R}{(R-1)+\frac{X}{L}}\right]2R$$

Case C $$N\left[\frac{1}{(R-1)+\frac{X}{L}}-\frac{R-1}{2\left\{(R-1)+\frac{X}{L}\right\}^2}-\frac{1}{R}+\frac{R-1}{2R^2}\right]2R^3$$

Case D $$N\left[\frac{1}{\left\{(R-1)+\frac{X}{L}\right\}^2}-\frac{2(R-1)}{3\left\{(R-1)+\frac{X}{L}\right\}^3}-\frac{R+2}{3R^3}\right]R^4$$

Case E $$N\left[\frac{1}{(R-1)+\frac{X}{L}}\left\{\frac{R-1}{2\left(R-1+\frac{X}{L}\right)}+\frac{R_1-1}{R-R_1}\right\}-\frac{1}{R}\left\{\frac{R-1}{2R}+\frac{R_1-1}{R-R_1}\right\}-\frac{R_1-1}{(R-R_1)^2}\cdot\ln\frac{(R-1+\frac{X}{L})R_1}{(R-1+\frac{X}{L})R}\right]\frac{2R_1R^3}{R-R_1}$$

DEFLECTION d at x DISTANCE FROM LOAD

Case A $$Q\left[1+\frac{1}{2}\left(\frac{X}{L}\right)^3-\frac{3}{2}\left(\frac{X}{L}\right)\right]$$

Case B $$Q\left[\frac{1}{2}+\frac{1}{2}\left(\frac{X}{L}\right)^2+(R-2)\frac{X}{L}-(R-1)+(R-1)\cdot\frac{X}{L}\ln\frac{R}{(R-1)+\frac{X}{L}}+(R-1)^2\cdot\ln\frac{R}{(R-1)+\frac{X}{L}}\right]3R$$

Case C $$Q\left[\frac{R+1}{2R^2}\cdot\frac{X}{L}+\frac{(R-1)^2-2}{2R^2}-\frac{R-1}{2\left\{(R-1)+\frac{X}{L}\right\}}+\ln\frac{R}{(R-1)+\frac{X}{L}}\right]3R^3$$

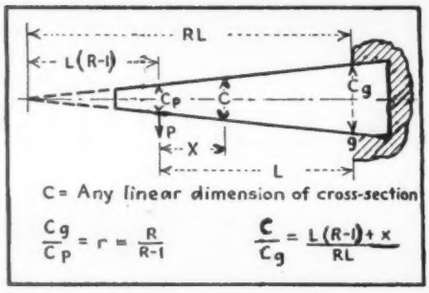
Case D $$Q\left[\frac{R-1}{2\left\{(R-1)+\frac{X}{L}\right\}^2}-\frac{3}{2\left\{(R-1)+\frac{X}{L}\right\}}-\frac{1}{R^3}\left\{\frac{R+2}{2}\cdot\frac{X}{L}+R^2+R+1\right\}\right]R^4$$

Case E $$Q\left[\frac{R-1}{2\left\{(R-1)+\frac{X}{L}\right\}}-\frac{R-1}{2R}-\frac{R-1}{2R^2}-\frac{R_1-1}{(R-R_1)R}-\frac{R_1-1}{R-R_1}\ln\left(R-1+\frac{X}{L}\right)\right.$$
$$\frac{(R_1-1)(R_1-1+\frac{X}{L})}{(R-R_1)^2}\left\{\ln\left(R_1-1+\frac{X}{L}\right)-1\right\}+\frac{X}{L(R-2)}\left\{\frac{R-1}{2(R-2)}+\frac{R_1-1}{R-R_1}-\frac{(R_1-1)(R-2)}{(R-R_1)^2}\cdot\ln\frac{R}{R_1}\right\}+$$
$$\frac{(R_1-1)(R-1+\frac{X}{L})}{(R-R_1)^2}\left\{\ln\left(R-1+\frac{X}{L}\right)-1\right\}+\frac{R_1-1}{R-R_1}\cdot\ln R-\frac{(R_1-1)R}{(R-R_1)^2}\left\{\ln(R)-1\right\}+$$
$$\left.\frac{(R_1-1)R_1}{(R-R_1)^2}\ln\left\{(R_1)-1\right\}+\frac{R_1-1}{(R-R_1)^2}\ln\frac{R}{R_1}\right]\frac{3R_1R^3}{R-R_1}$$

of which the others are particular instances).

In case A the conversion factor is 100 per cent, hence the slope and deflection are as found by the elastic curve equation. In the other cases, conversion factors expressed in per cent, to be applied directly to the slope and deflection, are given below.

Where the slope or deflection is required at points between the load and fixed ends the table cannot be used. The formulas must be derived without imposing the conditions for maximum value, and for that case the several expressions are as shown in the illustration at the left. For convenience, these are given in terms of taper factors R and R_1 rather than in terms of dimension ratios r and r_1.



Taper factor R and dimension ratio r

SLOPE of TAPERED BEAMS
IN PER CENT OF N,
THE MAXIMUM SLOPE OF A UNIFORM BEAM

r / r1	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0
1.0	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240	250	260	270	280	290	300
1.1	103	114	124	135	145	156	166	177	188	198	209	219	230	241	251	262	273	283	294	305	315
1.2	106	117	128	139	150	161	172	183	195	206	217	228	239	251	262	273	284	296	307	318	330
1.3	109	120	132	143	155	166	178	189	201	213	224	236	248	260	272	284	295	307	319	331	343
1.4	111	123	135	147	159	171	183	195	207	219	232	244	256	269	281	293	306	318	331	343	356
1.5	113	126	138	150	163	175	188	200	213	225	238	251	264	277	290	303	316	329	342	355	368
1.6	116	128	141	153	166	179	192	205	218	231	245	258	271	285	298	312	325	339	352	366	380
1.7	118	130	143	156	170	183	196	210	223	237	251	264	278	292	306	320	334	348	362	377	391
1.8	119	133	146	159	173	186	200	214	228	242	256	270	285	299	313	328	342	357	372	386	401
1.9	121	135	148	161	176	190	204	218	233	247	262	276	291	306	321	336	351	366	381	396	411
2.0	123	136	150	164	179	193	208	222	237	252	267	282	297	312	327	343	358	374	390	405	421
2.1	124	138	152	167	181	196	211	226	241	256	272	287	303	318	334	350	366	382	398	414	430
2.2	126	140	154	169	184	199	214	229	245	261	276	292	308	324	340	356	373	389	406	422	439
2.3	127	142	156	171	186	202	217	233	249	265	281	297	313	330	346	363	380	397	413	431	448
2.4	128	143	158	173	189	204	220	236	252	269	285	302	318	335	352	369	386	404	421	438	456
2.5	130	145	160	175	191	207	223	239	256	272	289	306	323	340	358	375	393	410	428	446	464
2.6	131	146	162	177	193	209	226	242	259	276	293	310	328	345	363	381	399	417	435	453	472
2.7	132	147	163	179	195	212	228	245	262	279	297	314	332	350	368	386	405	423	442	460	479
2.8	133	149	165	181	197	214	231	248	265	283	301	318	336	355	373	392	410	429	448	467	486
2.9	134	150	166	183	199	216	233	251	268	286	304	322	341	359	378	397	416	435	454	474	493
3.0	135	151	168	184	201	218	236	253	271	289	307	326	345	364	383	402	421	441	460	480	500

DEFLECTION of TAPERED BEAMS
IN PER CENT OF Q,
THE MAXIMUM DEFLECTION OF A UNIFORM BEAM

r / r1	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0
1.0	100	107	114	121	128	134	140	146	152	158	164	169	174	179	184	189	194	199	203	208	212
1.1	102	110	118	124	131	138	145	151	157	163	169	174	180	185	191	196	201	206	211	215	220
1.2	104	112	120	127	135	141	148	155	161	167	173	179	185	191	196	202	207	212	217	222	227
1.3	106	115	122	130	137	145	152	158	165	171	178	184	190	196	201	207	213	218	223	229	233
1.4	108	116	125	132	140	147	155	162	168	175	182	188	194	200	206	212	218	223	229	234	240
1.5	110	118	127	135	142	150	157	165	172	179	185	192	198	205	211	217	223	228	234	239	245
1.6	111	120	128	137	145	152	160	167	175	182	189	195	202	208	215	221	227	233	239	245	251
1.7	112	121	130	138	147	155	162	170	177	185	192	199	205	212	219	225	231	238	244	250	255
1.8	114	123	132	140	149	157	165	172	180	187	195	202	209	216	222	229	235	242	248	254	260
1.9	115	124	133	142	150	159	167	175	182	190	197	205	212	219	226	232	239	246	252	258	264
2.0	116	125	134	143	152	160	169	177	185	192	200	207	215	222	229	236	243	249	256	262	269
2.1	117	126	136	145	154	162	171	179	187	195	202	210	217	225	232	239	246	253	259	266	272
2.2	118	127	137	146	155	164	172	181	189	197	205	212	220	227	235	242	249	256	263	269	276
2.3	119	128	138	147	156	165	174	182	191	199	207	215	222	230	238	245	252	259	266	273	280
2.4	119	129	139	148	158	167	175	184	193	201	209	217	225	233	240	247	255	262	269	276	283
2.5	120	130	140	150	159	168	177	186	194	203	211	219	227	235	242	250	257	265	272	279	286
2.6	121	131	141	151	160	169	178	187	196	204	213	221	229	237	245	252	260	267	275	282	289
2.7	122	132	142	152	161	171	180	189	197	206	215	223	231	239	247	255	262	270	277	285	292
2.8	122	133	143	153	162	172	181	190	199	208	216	225	233	241	249	257	265	272	280	287	295
2.9	123	133	144	154	163	173	182	191	200	209	218	226	235	243	251	259	267	275	282	290	297
3.0	124	134	144	154	164	174	183	192	202	211	219	228	236	245	253	261	269	277	285	292	300

In these tables r represents the dimension ratio in the direction of load, while r_1 represents the dimension ratio transverse to the load. It will be noted that the top row of values corresponds to case C, the left-hand column to case B, the diagonal series from upper left corner to lower right corner to case D, and the remainder to case E.

Revenue and Sales at Peak

January energy sales were 15 per cent above 1936 and revenue 8.6 per cent — Rate dropped to 4.69 cents

RISING as usual to the winter peak, the revenue of the electric light and power industry in January established a new record. The total amounted to $194,554,000, according to the Edison Electric Institute, and the gain over the corresponding month of the preceding year was 8.6 per cent, or slightly larger than in November and December. The increase over December was close to $7,500,000, or 4 per cent, and exceeded by a considerable margin the increase a year ago, $5,700,000, and two years ago, $6,300,000.

The highest previous January was that of 1930, when the revenue from ultimate consumers was $185,322,200. Until last December that was the largest month's revenue in the history of the industry.

Energy production amounted to 9,613,661,000 kw.-hr., which is 10 per cent more than the corresponding figure for 1936, but this comparison understates the increase because the E.E.I. total excludes some plants formerly included. Comparing like plants in both years the Institute reports an increase of 11.5 per cent.

Sales to ultimate consumers were greater than ever before, aggregating 8,359,483,000 kw.-hr. This shows an increase of 24 per cent over January, 1930, whereas the revenue increased only 5 per cent during the same interval. Thus the downward trend of rates continues. Compared with a year ago sales rose 14.9 per cent, which again is much more than the gain in revenue.

The largest single class is wholesale commercial sales, up 19.4 per cent over 1936 and constituting more than half the total. In this class there has been a moderate recession from the all-time peak of last October, but such a recession is normal. This year's was smaller than usual.

Domestic and retail commercial sales both established new peaks, 13.7 and 15.2 per cent higher, respectively, than a year ago. The average domestic rate for the twelve-month period has fallen to 4.69 cents.

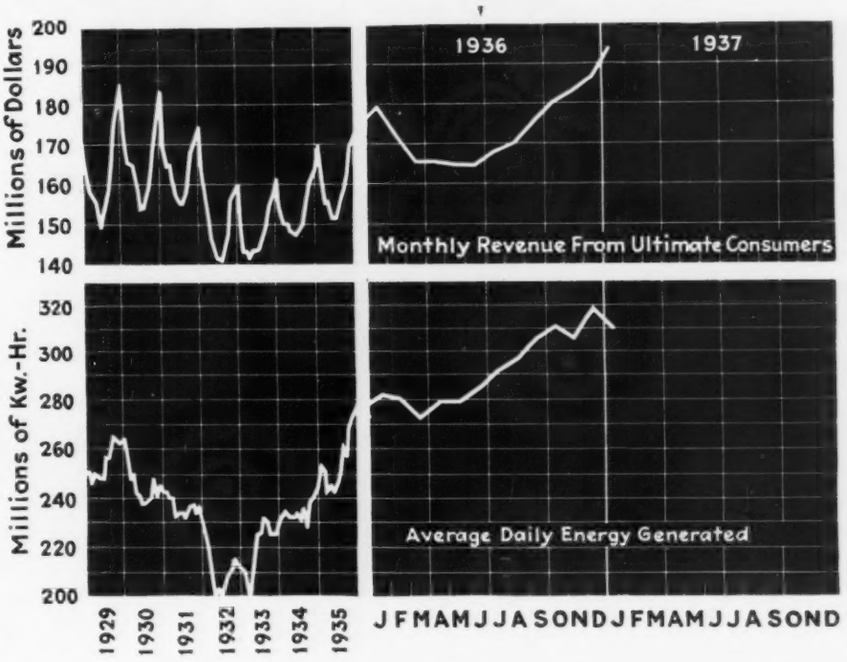


Table I—Monthly Revenue from Ultimate Consumers and Energy Output of Central Stations in the United States

Compared with Corresponding Month of Previous Year

Month 1937	Revenue from Ultimate Consumers‡		Energy Generated, Millions of Kw.-Hr.*					
			Total		Hydro		Fuel	
	Thousands of Dollars	Per Cent Inc.	Gen.	Per Cent Inc.	Gen.	Per Cent Inc.	Gen.	Per Cent Inc.
January	194,554	+8.6	9,614	+10.0	3,605	+11.0	6,009	+9.0
1936								
December	187,094	+7.9	9,859	+15.0	3,314	+8.0	6,545	+18.7
November	183,066	+8.1	9,171	+11.8	3,033	—0.7	6,138	+19.1
October	179,972	+10.6	9,639	+15.3	3,137	+17.6	6,502	+14.2

Table II—Regional Revenue and Energy Output in January, 1937

Compared with Corresponding Month of Previous Year

Geographical Region	Revenue from Ultimate Consumers		Energy Generated, Millions of Kw.-Hr.*					
			Total		Hydro		Fuel	
	Thousands of Dollars	Per Cent Inc.	Gen.	Per Cent Inc.†	Gen.	Per Cent Inc.†	Gen.	Per Cent Inc.†
United States	194,554	+8.6	9,614	+10.0	3,605	+11.0	6,009	+9.0
New England	16,526	+6.4	669	+12.0	352	+47.0	317	—11.0
Middle Atlantic	56,566	+8.0	2,482	+13.0	840	+43.0	1,642	+2.0
East No. Central	45,763	+8.4	2,370	+12.0	197	+23.0	2,173	+12.0
West No. Central	16,663	+6.9	651	+14.0	163	+10.0	488	+16.0
South Atlantic	24,109	+10.2	1,197	+6.0	753	+8.0	444	+3.0
East So. Central			385	+1.0	300	—3.0	85	+19.0
West So. Central	10,529	+11.5	453	+17.0	46	+127.0	407	+11.0
Mountain	5,768	+9.7	297	+4.0	180	—8.0	117	+30.0
Pacific	18,630	+10.4	1,110	+2.0	774	—2.0	336	+61.0

* By courtesy of Federal Power Commission, with deductions for operations not regarded as central station
‡ Edison Electric Institute. † Due to the elimination of some plants formerly included the percentages are only approximate.

Table III—Allocation of Energy January, 1937

Compared with Corresponding Month of Previous Year
(Edison Electric Institute)

Class of Service	Millions of Kw.-Hr.	Per cent Inc.
Total for distribution*	9,792	+13.0
Lost in transmission, etc.	1,433	+ 3.4
Sold to ultimate consumers	8,359	+14.9
Domestic	1,668	+13.7
Com'l, small light and power	1,616	+15.2
Com'l, large light and power	4,258	+19.4
Municipal street lighting	218	— 6.8
Railways—street, interurban	410	— 8.0
Railroads—electrified steam	118	+18.0
Municipal and miscellaneous	71	+15.9

* Generated, purchased from other sources, imported, less energy used in railway and other departments.

Editorials

HOWARD EHRLICH . EDITOR

The Limitations of the Superposition Trend

THE so-called "superposed power plant" is one in which new high-pressure, high-temperature generating plant has been installed to furnish steam to a lower pressure turbine. By this means the over-all operating efficiency of many old stations can be greatly improved and the useful life of the older turbines can be extended. But is this always the correct method of securing additional capacity?

Superposition, while it has been employed for many years, has only recently achieved widespread popularity. This has been due largely to the present urge not only to reduce generating costs but also to decrease the investment required for added capacity. Both objects may be achieved in many insallations and their employment justified, provided basic assumptions are correct.

What is the true operating life of turbines built from ten to twenty years ago which may serve as the low-pressure units of the superposed plant? Exact data are lacking. It is true that many twenty-year-old turbines are still operative. This age has been considered in the past as about the economic life of such equipment. Superposition provides for considerable extension of this operating life. Will these turbines meet present expectations?

Under present conditions these older units carry the peak and low load factor portions of the load. Their operating hours per year are often relatively few and their average loads rather low. Obviously an increase of operating hours and loads necessary under the new superposed conditions must increase the number of repetitions of stress, both under fatigue loading and in vibration. Failure may occur from both of these causes after a certain number of repetitions of stress. Hence an increase in the number of failures of disks and blading, with consequent maintenance outages, may be expected from these older units in the superposed plant. Have these possibilities been given full consideration? Will the availability of the superpositioned plant equal that of an entirely new station?

It is also reasonable to assume that the older units will wear out sooner than the new superposed high-pressure turbines. What, then, is to be done with the superposed plant? Will new low-pressure units be installed which in turn will outlast the present superposed unit? Or are the superposed plants being justified on the basis of a useful life only equal to that of the present older units?

Superposition has limitations as well as advantages. Are all of these fully considered when superposition is chosen?

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Recording the Lessons of Floods

RECOVERY from the record-breaking floods is in full swing along the Ohio. The cities are rehabilitating and the utilities have their similar problems, except that they have had to be far more effective in their resumption of normal functioning. Lessons are being learned about two things—what to do quickly when Nature hits you unawares and what to do so Nature can hardly hit you unawares again.

From an operating standpoint the disposition now is to crystallize the planning for future protection of service. One thing that should not be overlooked is that the best laid plans of mice and men oft go astray, and it is well, therefore, to have a reservoir of emergency expedients on tap to meet unprecedented obstacles with dispatch.

A flood exceeding all forecasts introduces all sorts of new problems. What should be done to protect equipment and maintain or restore service at the plants, through the substations, along the underground and over the overhead in flooded districts? The lessons of the 1937 floods are yet to be told, and ELECTRICAL WORLD plans to record them as soon as stress of recovery affords an opportunity to be meditative and constructively reminiscent.

•

Advertising to Build and Hold Business

SOME figures on the advertising expenditures of a group of power companies, that may or may not be altogether typical, are sufficiently surprising to be deserving of comment.

These several power companies, with a combined gross income of $14,500,000 from domestic customers, for advertising electric service, not appliances, to these customers, spent in 1936 sums ranging from eight to twenty cents per customer, fractions of one per cent of their domestic revenue. For advertising appliances in direct merchandising, an incidental activity, they spent about four times as much as for advertising their primary product, electric service. These same com-

panies in 1936 had a combined revenue of $10,000,000 from commercial customers and they spent altogether $1,200 in that year to advertise their service in that field. Still infinitesimal, but relatively better, is the expenditure of $3,500 for advertising electricity to power customers who paid $12,000,000.

Manufacturers of cigarettes, automobiles, food, and what have you, know that advertising is essential to hold their customers and to hew out a larger part of the public's dollar. Isn't this the same business problem of the utilities? True, residential customers have no other place where they can purchase power, but might not they buy more? And as for commercial and industrial customers, there are competitive forms of power.

This particular group of companies could multiply its advertising expenditures to the commercial and industrial markets by ten and, if it prevented the loss of but one good-sized customer, it would have paid for itself. Advertising of this kind is not to be confused with public relations. It is business building and business holding and should be so considered in the expense statement.

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Detachable Meters Next for Industrial Testing

NOW that the socket form of watt-hour meter has firmly established itself among power companies it is natural that the detachability idea should spread to the indicating and recording types of instruments. This step should bring a decided tendency for industrial plants to take more interest in instrumentation. Power circuits are the nerves and arteries of productive industry. Meters inserted into those circuits give neatly the electrical information which may be worth little for its own sake, but most valuable in telling whether a motor is in danger because of overloading, a furnace is operating inefficiently, light is being sacrificed to low voltage, a department is functioning at a costly power factor or the operators are encountering too many interruptions.

In the past the deterrent to wider use of electrical instruments in industrial plants has been more the cost of installing the instruments properly than of buying them. But the sockets as developed for watt-hour meters cost only a fraction of the price of suitable indicating instruments. Further, the cost of installation is low because the socket is inserted in the conduit run, is self-supporting and requires no panel. With the expense ratio thus reversed it is reasonable to expect that the prospective availability of the new scheme for instrument mounting will give industry what it has been waiting for—a chance to analyze productive efficiency through measurement of the electrical input, which has become the indispensable factor in modern controlled production.

The Engineer's Public Responsibility

FOR SOME years past thoughtful men in the various fields of engineering have become more and more concerned about the social responsibility of the engineer. Many papers have been published, many talks have been made, all of them implying, if not saying outright, that the engineer has failed to measure up to the duty that is his as a member of society.

Before 1929 the engineer hired out his talent and in many cases built plants and structures the only reason for construction of which was financial exploitation. And when the world turned awry the engineer was soundly berated for having blindly permitted his genius and capacity to be used in an unwarranted and unwholesome expansion of capital facilities. In effect, the engineer was accused—and the accusation was uncomfortably near the truth—of being a mere wage slave eager to do the bidding of predatory finance.

And now, after eating the bread of idleness, the engineer is back at work again, but under a new master whose name is politics. And, hard as it is to believe that the thing is possible, the talent and genius of the engineer are being worse exploited, more perverted to wasteful and uneconomic ends, than in the unregenerate years of the twenties. Projects of river development involving navigation, flood control, power and irrigation that aforetime received no serious consideration, but only derision, in engineering circles, are now seen to be meritorious, worth-while undertakings in their new clothing of government millions that hides their economic rottenness from sight. The engineer is again contributing his share of folly to be stored up against the day of wrath.

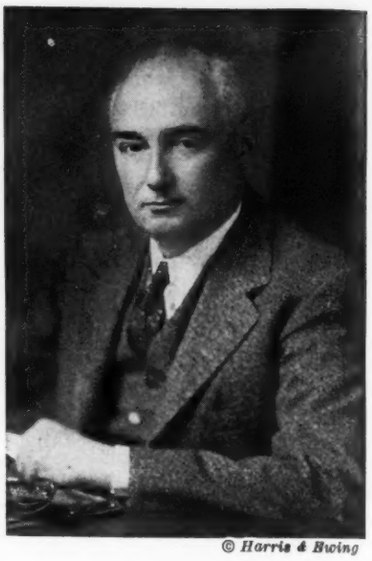
But perhaps the engineer learned something from the scoldings and the sufferings that were visited upon him as he was made a scapegoat to carry a major part of the blame for the depression. In professional engineering bodies there is working a leaven of revolt against the hidebound policies that attempt to hold the interest of the engineer in a narrow, technical groove. Stronger and stronger grows the conviction that the engineer must not hypothecate his professional integrity. And, too, from the world outside come questions that help the engineer to speak the truth that, of himself, he is afraid to utter. Representative of such questions is that asked by Raymond Moley in a recent issue of *Today:*

"All of us who are not engineers have been taught to believe that water power is the cheapest and most efficient and most permanent source of power. Are we right or have we put our faith in a delusion?"

With the pressure that is accumulating within the profession and with the demand for the truth that is growing outside, it may be that the engineer will find courage to tell what he knows to the people.

Boulder Out of Step

By CARTER FIELD



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This noted journalist gives his personal comments and interpretations on current happenings affecting the electrical industry. His background and his location in Washington make his thoughts informative and interesting even though all may not agree with him.

NO WONDER they are squabbling about the rates, terms and conditions of the sale of electric power at Boulder Dam—the one that used to be Hoover Dam, you know. The whole thing was arranged, so far as the contractual details are concerned, way back in 1930. There was no thought of a "yardstick." There was the quaint idea that the project should pay for itself—and return the money to the U. S. Treasury plus 4 per cent interest.

There was the idea that the whole thing should be amortized in 50 years, and the machinery in ten years, against the possibility of new processes and new machinery making process and machinery obsolete. There was the further novel idea that two of the states involved, Nevada and Arizona, should get a cut of the profits in lieu of the taxes they would receive if the whole project were privately owned. And finally there was the thought that there should be profits—after amortization had been completed—to compensate the states up the Colorado basin.

To make the mental processes of this long past era—1930—still more extraordinary—in the light of present-day governmental theories—it must be realized that the main idea of the whole project was water—not power. Yet the power development was saddled with the entire cost!

And one is not surprised that the California power users—the chief beneficiaries—are now alarmed and protesting to the White House, and through their spokesmen at the recent Bowlder Dam Conference, that cheap power at the newer government development, Bonneville, may lure away customers and industries which otherwise might have come to California to obtain cheap power from Boulder Dam.

The interest rate of 4 per cent is too high, they insist. The government should charge off part of the capital cost to navigation and flood control—back in 1930 much was said about navigation to justify the constitutional power of the federal government to take a hand. Of course that was long before President Roosevelt's irritation at the straitjacket conception of the Constitution by the present Supreme Court started the move for six more justices of the New Deal variety. And it was before the new majority conception of interstate commerce embodied in the Wagner act decision. In fact, it was before a lot of things.

For there was a distinctly states' rights tinge to the whole picture, which is part of the real explanation, the more important part of which is the change in attitude on the part of the government as to what terms and conditions should govern the enterprise when the government entered upon a business function.

The set-up which California is now so eagerly seeking to change was based upon negotiations between seven sovereign states—California, Arizona, Nevada, Colorado, Utah, Wyoming and New Mexico.

All had to agree before the project could be approved. So naturally there was the same sort of give and take which normally occurs when business men or nations reach any agreement which is of direct monetary interest to all of them. There was no question of assessing the taxpayers and not giving a whoop whether the project was economically sound or not. There was no question of using the whole sum of capital to be expended primarily as a lever to force certain private interests to cut their rates. It was, in fact, a business proposition.

Another intriguing feature of that ancient contract was that the government did not sell *electricity*. Far from it. It sold *falling water*. But the whole situation is admirably and briefly stated by Commissioner of Reclamation John C. Page:

> The Boulder Canyon Project Act established a special fund of not to exceed $164,000,000 for construction of the Boulder Canyon project. All advances to this fund are to be repaid and the amounts used for construction of Boulder Dam and power plant are to be repaid within fifty years with interest at the rate of 4 per centum per annum compounded annually. The sum of $25,000,000 of the cost of Boulder Dam is allocated to flood control. If during the period of amortization revenues are in excess of the amounts necessary to meet the periodical payments to the United States, 18¾% of such excess revenues is to be paid to each of the states of Arizona and Nevada, in lieu of taxes which these states might have received had the Boulder power development been a private undertaking, and 62½ per cent of such excess revenues is to be applied to repayment of the $25,000,000 allocated to flood control.

Mr. Page goes on to say in the same statement:

> The charges for use of falling water of 1.63 mills per kilowatt-hour for generation of firm energy and ½ mill per kilowatt-hour for generation of secondary energy were determined in accordance with the provisions of Section 5 (a) and (c) of the Boulder Canyon Project Act on the basis of the cost of competitive power from private and municipal plants delivered at the load center of Los Angeles, at the time the power contracts were entered into (1930), less the estimated cost of transmitting Boulder dam power to that load center.

We ask you!

It seems now that the rates were fixed so high that the amortization will be completed in "considerably less than 50 years." Also novel, from present-day viewpoints, is the fact that the power plant is operated and maintained, under lease, part by the city of Los Angeles and part by Southern California Edison Company, Ltd.

But this is too much. Now we know you won't believe any of it!

Letters TO THE EDITOR

Disputes Field on Energy Tax

To the Editor of ELECTRICAL WORLD:

We subscribe to and appreciate the value of your publication, ELECTRICAL WORLD, and we feel that it is not your purpose to print in this publication misinformation or statements that are untrue. Because of this conviction, we are writing this letter, a complaint if you will, based upon an article in the January 16, 1937, issue, said article written by Carter Field.

We are prompted especially in this complaint by the note at the top of the article: "His background and his location at Washington make his thoughts informative."

In his article Mr. Field writes, in speaking of the electrical energy tax, that "originally this tax was paid by the consumers; the only discrimination lay in the fact that it was not levied against municipal plant electrical consumers. In short, it operated to distort the yardstick by which the savings to the people through municipal operation would be measured."

I must emphatically refute this statement by Mr. Field and challenge him to show by any authoritative record that his statement applied to all municipal plants with regard to the energy tax. Permit me please to advise you that municipal plants in the State of Massachusetts, including the Shrewsbury Municipal Light Department, levied a tax upon its domestic customers from June, 1932, to December 31, 1934. This tax was collected from the consumers and forwarded to the Internal Revenue Department of the United States.

Naturally when I see an article in your magazine or any other magazine which is an unfair and uncalled for criticism or comparison of municipal operation with private operation, I am not constituted to let such statements go unchallenged.

I would like very much to have you call this matter to the attention of Mr. Field and I would greatly appreciate your reaction to this complaint.

E. A. LOGAN,
Manager Municipal Light
Department, Shrewsbury, Mass.

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To the Editor of ELECTRICAL WORLD:

Mr. Logan is absolutely right. My memory was sour in that I remembered the bitter difference between the House and Senate on this tax on electrical energy, which was believed later to be largely responsible for the defeat of Judge Crisp. Crisp was alleged to have been the man who, in the conference between the House and Senate, forced acceptance of the idea that the 3 per cent tax should be added to the bills and therefore, of course, paid by the customers.

The following year, in the act which passed in June, 1933, this tax was changed to a direct imposition on the electrical companies. At the same time, the original exemption, which applied only to purchasers who happened to be government agencies, was expanded so that from then on the tax did not apply to any governmentally owned electrical plants.

CARTER FIELD.

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Contributes Data on Welder Energy Use

To the Editor of ELECTRICAL WORLD:

In the ELECTRICAL WORLD, issue of March 27, 1937 (page 39), is an article by L. J. Lamberger of the Duquesne Light Company entitled "Modernization and New Uses Help the Power Salesman." On page 40 of that article the statement is made that "electric welding was known long before the recent depression, and even prior to that time numerous patents had been granted."

It is interesting to note that the patents on welding go way back into the '80s, but of course its modern use has only been within the last ten or fifteen years. May I offer the suggestion that in reading through this article starting on page 40, under "New Uses and New Applications," that unless it is very carefully read one would gather the impression that the seam welder is the one which is being used to weld the deck plates and side plates on river boats and barges and also on storage tanks. These jobs are electrically arc welded, as is illustrated on page 41. As I mentioned before, it would be taken from the article that these are done by a seam welder, this being particularly noticeable in the title of the first column on page 41, "New Uses for Seam Welder."

May I suggest also the fact that just an ordinary arc welder used for just normal performance would result in the use of, say, 10,000 lb. of electrode per year. Now for every pound of electrode purchased the power companies, on electric-driven equipment of course, get 1¾ kw.-hr. This would mean, then, 17,500 kw.-hr. for each arc welder. This would be a minimum power demand for use and may go to figures higher because of higher kilowatt-hours per pound, this being dependent, of course, upon a great number of conditions, or it may go higher because of the use of more electrode. But it is at least a conservative figure. I therefore suggest that the matter of proper designation of the equipment used be clarified in an article of this kind.

I trust that you will accept these remarks in the spirit in which they are sent; that is, a matter of accurate information.

E. W. P. SMITH,
Consulting Engineer
Lincoln Electric Company,
Cleveland, Ohio.

Washington School Lighting Values Checked

To the Editor of ELECTRICAL WORLD:

In reply to the comments by Davis H. Tuck in the March 13, 1937, issue of ELECTRICAL WORLD on the article "Washington Schools Lead in Lighting," by Aksel Knudstrup, which appeared in the January 16, 1937, issue, may I state that I have personally checked the foot-candle values given in this article and found that the readings taken were of the same magnitude as those mentioned.

My readings in classrooms of five buildings were taken on desk tops, using two Weston meters which were recently calibrated at the U. S. Bureau of Standards. Mr. Tuck's calculations, using "Illumination Design Data," are, of course, based on an average illumination throughout the entire room, and to obtain this with light meter readings it would be necessary to take one reading for every square foot of floor area in the room and then average the results. Readings in a classroom are normally taken on the desks, which are fairly well toward the center of the room, and beyond a doubt the intensity is considerably higher at these places. The readings that would be taken around near the wall (especially the blackboard walls) constitute a considerable portion of the whole, because of the length involved; therefore, the lower illumination near the walls would require a much higher illumination in the center to offset it and produce the average figure.

All illumination readings taken were in classrooms of buildings completed within the last year, and hence they represented relatively clean conditions. Lighting calculations, to determine present intensities of illumination in buildings of this type, should not apply much of a depreciation factor. As Mr. Knudstrup's article was not a lengthy treatise on the subject, he probably did not have the space to explain this point in more detail.

With respect to Mr. Tuck's reference to the excessive ceiling brightness—"if 38-52 ft.-candles were actually secured by the use of indirect lighting"—and stating that this "would represent poor practice for the ceiling would be offensively bright," he should be reminded that the classrooms mentioned are not more than 33 feet long. Even the students seated in the back seats do not get a very large expanse of ceiling in their field of view and the effect is quite comfortable. Mr. Tuck has overlooked the point that what may be very offensive in a large room may be altogether comfortable in a small room.

ROBERT C. BLATT,
Electrical Engineer for the
Municipal Architect,
Washington, D. C.

News OF THE WEEK

Charge TVA Spreads Propaganda of Its Intent to Destroy Utilities

Baker asks court to continue injunction against expansion of power activities of TVA — Questions constitutionality of act — Birmingham court enjoins Alabama Power from joining major utilities in suit

Charges that the TVA is spreading propaganda all through the Tennessee Valley of its intention to destroy private utilities and take them over were made last week by Newton D. Baker, war-time Secretary of War, before the United States Sixth Circuit Court of Appeals.

Concluding oral arguments on the TVA's appeal from an injunction granted to nineteen Southern power companies by Federal Judge John Gore, enjoining TVA's power expansion program, Mr. Baker expressed doubt as to the constitutionality of the amended TVA act.

Fly sees loss to public

J. L. Fly, TVA solicitor, argued that the case was "an awful collection from the Ashwander case." The government argued that it would lose $1,400,000 should the injunction be continued in force and that "this does not include the loss to the public in failing to obtain the benefits of the government-owned power or to the authority in the disruption of its organization."

The case was heard by Judges Florence Allen, Charles Moorman and Charles Simon. The court recessed until May 4, after allowing government counsel to file additional briefs.

The United States District Court at Birmingham last week enjoined the Alabama Power Company from joining other major utilities in an injunction suit against the expansion of power activities of the TVA. District Judge David J. Davis granted the TVA the right to expand its electrification program in Alabama.

Recently the Georgia Power Company was enjoined from participating in the suit originally brought by nineteen utility operating companies which claimed "unfair competition" from the government power agency. Federal Judge John J. Gore granted the original injunction pending a determination of the constitutionality of the entire TVA act.

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Sees Acute Shortage of Power in TVA Area

An acute shortage of electric power in the area served by the TVA is approaching, according to Dr. Arthur E. Morgan, TVA chairman. Speaking before the Phi Beta Kappa Association in Boston this week, Dr. Morgan disclaimed familiarity with other sections of the country although it was his impression that the shortage was general.

Two years ago, Dr. Morgan declared, the utilities contended there was a great over-capacity of producing facilities but now in the area within transmission distance of TVA at least they are in distress because of lack of capacity.

He said that at present the TVA has about 250,000 kw. and that will be doubled in two years or so and "we believe all this additional power will be needed when we are in position to deliver it unless the whole business structure completely changes." Dr. Morgan said that he felt there is a shortage of capacity because "old type plants which should only be used as standbys are being employed as regular equipment." He added that manufacturers of steam generators, unable to promise delivery in less than a year, are being forced to turn out old type generators because they cannot wait for plans to come through for the newest types.

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Propose Modification in Boulder Contracts

Proposals for the modification of existing contracts covering sale of power from Boulder Dam made last week at a public hearing indicate that some difficulty will be experienced in finding a ready market for the power and that revenues for amortization of the $165,000,000 investment may be slow in reaching levels anticipated.

The Metropolitan Water District of Southern California proposes to defer taking its allotment of power for two years until completion of the aqueduct. It also proposes lengthening of time when it must take its maximum amount of power; the time to amortize generating equipment from 10 to 50 years, lowering the interest rate from 4 to 3 per cent; the principle of requiring power revenues to repay parts of the investment charged to other purposes which is not followed by Bonneville, Grand Coulee and the TVA, and that the government absorb the $25,000,000 for flood control and $5,000,000 for navigation.

Los Angeles has the same objectives as the Metropolitan District, but feels that it should operate the plant.

William W. Ray, Attorney-General of Utah, pointed out that the Boulder project was conceived and carried out primarily as a water and not a power development. He said power users were repeatedly warned that they might not be able to compete with steam power.

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Uniform Accounts Hearing Postponed

Maryland Public Service Commission has postponed its hearing on the proposal to put into effect in the state the revised uniform system of accounts for electric utilities recommended by the National Association of Railroad and Utilities Commissioners, covering Classes A, B, C and D. Originally set for public hearing at the commission's offices in Baltimore on April 12, the case has been postponed until April 26.

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To Make $371,000 Addition

New equipment to increase the capacity of the Delaware substation of the Indiana General Service Company, Muncie, will be installed within the next four or five months, company officials have announced. The estimated cost of the equipment is $371,000. The present capacity of the substation is 50,000 hp. and the new equipment will increase the capacity to 100,000 hp.

Kellogg Says Steam Stations Can Generate Power at 41% TVA Cost

E.E.I. head asserts $231,291,000 difference in calculations of Army engineers and TVA cost of dams must be charged to power — Favors steam plants over hydro to reduce unemployment

Modern coal-burning steam plants can generate at 41 per cent of the estimated cost the firm power planned for production by the Tennessee Valley Authority system of hydro-electric plants, Charles W. Kellogg, president of the Edison Electric Institute, told the convention of the West Virginia Chamber of Commerce last week.

Mr. Kellogg stated that his statement was based on calculations of data gathered from official government records, although not those reported by the TVA to the public. He said that the excessively high premium that taxpayers must meet is based on the difference in cost between the type of dams now being constructed for both navigation control and power production and those recommended by War Department engineers as adequate for navigation purposes, primary object for which TVA was intended.

It was pointed out by Mr. Kellogg that the calculations of Army engineers showed that navigation dams could be built for $74,709,000, and that the present type of power dams will cost $306,000,000, exclusive of Wilson Dam. The difference of $231,291,000, he said, must be charged to power costs, although none is allocated to electricity by TVA authorities.

Mr. Kellogg said that additional operating charges and other expenses would bring the cost of TVA firm power to 9.5 mills per kilowatt-hour at the busbar. Modern steam plants can generate energy at 3.92 mills per kilowatt-hour, he said, about 41 per cent as large as the true cost at TVA as projected.

From a viewpoint of solving the unemployment problem, Mr. Kellogg declared, preference should be greatly in favor of steam stations compared with hydro because more labor is employed in their operations.

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Rocky Mountain Body Plans Sales Campaign

Formal consolidation of the activities of the Rocky Mountain Electrical Association and the Electrical League of Colorado was recently effected at a dinner attended by men and women representatives of every branch of the industry. The new organization will be known as the Rocky Mountain Electrical League and will establish local chapters throughout the territory.

The new organization will help finance local organizations, which will be confined to sales promotion activities, through support from manufacturers, distributors and others. Herb Names, R. Y. Chedister, Ross H. Adams, John J. Cooper, all of Denver, and Arthur Prager, of Albuquerque, will direct the activities of the five major divisions. Engineering, operating and accounting problems will be under the direction of Harry Adler and L. M. Robertson.

Officers of the League include Guy W. Faller, Public Service Company of Colorado, president; A. H. Heitzler, Public Service Company of Colorado; O. B. Summers, New Mexico Power Company; J. H. Jacobucci, Utah Power & Light; E. E. Brazier, General Electric Supply Corporation, vice-presidents; W. C. Sterne, Arvada Electric Company, Denver, treasurer; K. W. Kissick, Trinidad Electric Transmission, Ry. & Gas Company, Colorado, past-president, and George E. Lewis, Denver, secretary-manager.

NEW ASSOCIATION—Guy W. Faller, president of the newly formed Rocky Mountain Electrical League, receiving a double-barreled shotgun at the recent meeting. Harry Adler presented the gun on behalf of the members

Commonwealth & Southern Units Place Orders for Six Turbines

System companies in Indiana, Illinois, Ohio, Michigan and Pennsylvania will add to steam generating capacity — Work starts on new John C. Weadock plant near Bay City — Consumers Power expands

Orders have been placed for six turbines to be installed in plants of operating companies of the Commonwealth & Southern system in Indiana, Illinois, Ohio, Michigan and Pennsylvania. All of the turbines are designed to operate under identical steam conditions and all are for condensing operations.

A new extension is being built at the Ohio River station of Southern Indiana Gas & Electric, Evansville, which will include an 800-lb., 850 deg. steam turbine driving a 20,000-kw., 0.8-power factor, 3,600-r.p.m. air-cooled generator. A single boiler fired by pulverized fuel will supply the steam.

East Peoria plant

An extension to the East Peoria plant of Central Illinois Light Company is under construction. This involves a similar pulverized fuel steam boiler and a 25,000-kw., 3,600-r.p.m. turbine generating unit.

Construction work has been started on the John C. Weadock plant, on a new site near Bay City, Mich., for the Consumers Power Company. It will be a pulverized fuel plant and will include two 35,000-kw., 80 per cent power factor, hydrogen-cooled, 800-lb., 850 deg. turbo-generators, each supplied with steam by a boiler rated at 900 lb. and 900 deg. maximum. This plant will receive coal by boat due to its location at the mouth of the Saginaw River.

The new plant in southern Michigan, to be located on the Kalamazoo River, will be named for Bryce E. Morrow, who, at the time of his death over a year ago, was chief engineer and manager of the production and transmission department of the company. A 17-ft. head dam creating a 1,200-acre pond will be built to provide condensing water storage, making possible the development of this site for a major power supply to the area. The initial installation will consist of a 35,000-kw. turbine and boiler identical with the one of the John C. Weadock units.

A pulverized fuel installation with a 20,000-kw., 3,600-r.p.m. turbo-generator has been ordered for the Mad River plant of Ohio Edison Company.

Pennsylvania Power Company will have a 3,600-r.p.m., hydrogen-cooled, 35,000-kw. turbo-generating unit, similar to the Bay City set-up. This unit will be installed on a new site at New Castle, Pa.

In addition to the Bay City installation Consumers Power is expanding the Elm Street steam plant at Battle Creek, where an 800-lb. boiler and a 10,000-kw., 3,600-r.p.m. superposed turbine generator will effectively increase total capacity to 50,000-kw.

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Walsh-Healey Change Sought by Sponsors

A bill to amend the Walsh-Healey Public Contracts Acts of 1936 has been introduced in the House by Representative Healey, Massachusetts. Senator Walsh of Massachusetts proposed the bill in the Senate.

The principal changes contemplate the extension of the scope of the act to all contracts in excess of $2,500 (the present limit is $10,000) and contracts for services as well as supplies; to place on the ineligible list bidders persistently remaining in violation of the NLRA, and to require bids by dealers to contain certificates that the goods were manufactured in accordance with the labor conditions incorporated in the act.

Provisions are also made for preserving the basic 40-hour week, while making certain labor allowances regarding time off for overtime.

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Washington Utility Connects Power Line and Substation

Washington Water Power Company has connected the distribution systems of Garfield, Elberton, Oakesdale, Belmont and Farmington to the new 110,000-volt substation. The new substation replaced the old 60,000-volt one at Belmont, built in 1906. It will also serve Palouse, Wash., and Potlatch, Idaho, with 13,000-volt feeder lines.

The new 110,000-volt line from Tekoa to Garfield, built this past winter, and the substation will complete the 100,000-volt system of the company. L. C. Johnson, who worked on the Belmont substation 31 years, supervised the work on the transmission line and substation.

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Ford Plans Increase in Generating Units

An order for a 110,000-kw. turbine-generator has been placed with the General Electric Company by the Ford Motor Company. The unit will be part of a $5,000,000 installation which will be completed in about eighteen months.

The new vertical compound turbine will be a duplicate of the second 110,000-kw. unit, recently installed, for steam conditions of 1,200 lb., 900 deg. and 1-in. back pressure. The 1,800-r.p.m. high pressure turbine and generator are mounted on top of the 1,800 r.p.m. double-flow low pressure unit. Hydrogen cooling is employed for the generators, to provide for increased efficiency of operation. The generators will be the thirteenth and fourteenth large turbine-driven units designed for hydrogen cooling to be built at the Schenectady Works of General Electric.

Ford officials stated that with the new unit the Rouge power plant will have a total installation of 350,000 kw. and the increased power capacity would provide for a substantial increase in production.

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Pennsylvania Utility Bill Change Sought

The county executive board of the Pennsylvania Security League has adopted a resolution urging an amendment of the McArdle bill, now pending before the State Assembly, so as to provide for the county operation of public utilities by majority action of the county commissioners only, without referring the question to the people.

The resolution urges that the commissioners be empowered to create the utility administrative board on their own action. The bill in its present form allows an administration, if created, to acquire any and all utili-

ties it deems feasible for the county to operate by the issuance of bonds which would not be chargeable against the tax debt.

Fear of a lack of clarity in the issue to be presented to the people prompted the resolution, according to Samuel L. Fuss, chairman of the public transportation committee.

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Power Salesmen Plan Information Exchange

An interchange of information between power salesmen was suggested as a means of solving special sales problems by Ford Bates, Nebraska Power Company and chairman of the power sales committee of the Missouri Valley Electric Association.

At the meeting held recently in Kansas City, Mo., Mr. Bates stated that acquaintance of power salesmen in the region with others, the companies' service areas and the types of industrial customers would be of mutual benefit.

Discussions related to power sales organization and methods, new loads, sales possibilities, rate structure, selling air conditioning, industrial heating and meeting internal combustion engine competition.

Speakers included W. S. Baugh, Kansas Gas & Electric; P. S. Kendall, Kansas Power; Paul DeLeon, Wisconsin Power & Light; Herbert Henderson, Iowa Electric Light & Power; Anson D. Marston, Glen S. Young and B. J. George of Kansas City Power & Light, and W. H. Stueve, Oklahoma Gas & Electric.

Tennessee Electric Power Plans $2,000,000 Steam Generating Unit

Company to construct 25,000-kw. plant on Cumberland River to safeguard Nashville area against emergency power shortage—State utilities commission order may decide issue on purchase of TVA power

Tennessee Electric Power Company plans a new $2,000,000 steam-electric plant to safeguard Nashville and vicinity against an emergency power shortage, according to Jo C. Guild, president. Construction will start upon approval by the Tennessee Railroad and Public Utilities Commission.

The commission has issued a show cause order as to why the utility should not immediately increase the capacity. The company had previously advised the commission that power facilities in the Nashville area were rapidly becoming inadequate to meet the normal increase in business. It feared a shortage by next fall.

Would buy TVA power

Mr. Guild stated that the company was willing to purchase power from the TVA provided the government agency would refrain from "raiding" its power markets. This the TVA refused and insisted, as part of the consideration, that it be "left free and unhampered to raid the markets of the company."

It was pointed out by Mr. Guild that since the expiration of the contract with TVA on February 3 the TVA has insisted that any power sold by it shall be at its standard published rate. It was not until March 25, he said, "after we had made expenditures and commitments for the steam plant, that representatives of the TVA stated to us that no matter at how low a cost we can produce electric energy in a steam plant it will sell us power at a lower rate."

In 1929-30 Tennessee Electric Power spent more than $1,000,000 in building a high-power transmission line from Nashville to Muscle Shoals for the purpose of providing ultimately an interconnection with Alabama Power and making it possible for the government to dispose of its power at Wilson Dam.

Expenditures and commitments of more than $750,000 for land, turbine, generator, boiler and other equipment have been made for the new 25,000-kw. plant on the Cumberland River at Bordeaux.

The order of the Tennessee commission places that body in a position to decide whether it will force the purchase of TVA energy by the utility. Since March 15, when the commission issued an order providing that any construction by a private utility of new facilities exceeding $5,000 in cost must have its approval, utilities have been forced to seek such approval before beginning any major expansion program.

Mr. Guild stated that providing the territory with an assured source of power is paramount to the price TVA would sell its power.

CONFERENCE—A group of power salesmen at the recent meeting in Kansas City, Mo., of the Missouri Valley Electric Association

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Safe Driving Awards Given

Safe-driver awards were made to 33 employees of the Central Illinois Light Company at a dinner-meeting held recently in Springfield. The awards were for having driven trucks and commercial cars of the utility an aggregate of 549,452 miles without an accident. L. H. Lyman, safety director of the company, made the presentations. The safe-mileage dinner has been an annual function since the company started its no-accident movement three years ago.

Associated Opposes Commission Inquiry

Attorneys for Associated Gas & Electric interests, challenging the Federal Power Commission's authority to investigate six Pennsylvania utilities, pressed the commission for an immediate ruling to expedite an appeal, if necessary, to the federal courts.

The hearing was granted on the petition of Walter B. Saul, chief of the utilities' counsel, raising the question of the commission's jurisdiction in making the inquiry. The companies involved are Metropolitan Edison, Northern Pennsylvania Power, Pennsylvania Electric, Erie Lighting, Clarion River Power and Solar Electric. The purpose of the inquiry is to determine the justification for charges against the operating companies and to learn whether consumers' rates and service were injuriously affected.

At the opening of the hearing the commission refused to permit counsel for the companies to examine all correspondence exchanged by the commission, the Governor of Pennsylvania and the Pennsylvania Public Service Commission.

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Utility Plans Large Building Activities

An extensive program of construction must be carried forward to meet the increased demand for service and the company must adjust itself to operations under the Public Utility Act of 1935, H. Hobart Porter, president of American Water Works & Electric Company, declared at the annual meeting of stockholders this week.

Higher prices for materials, the necessity for adjusting wages to the increased cost of living, heavy expenditures required to comply with state and Federal regulations and higher taxes were factors seen by Mr. Porter as affecting the net income resulting from the increased gross.

The company has been actively engaged in preparing for permanent registration with the SEC, having filed the preliminary registration statement in February, Mr. Porter related.

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Senate Committee Reports Norris Utility Inquiry Bill

The Senate interstate commerce committee reported favorably this week a resolution, introduced by Senator Norris, appropriating $150,000 for a Federal Trade Commission investigation into propaganda activities by public utility companies. It is aimed particularly at alleged efforts to influence public opinion in regard to municipal ownership of electric plants.

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Proposes to Settle Standard Gas Suit

A proposal to compromise and settle for $1,000,000 all alleged claims existing in favor of Standard Gas & Electric Company against certain officers, directors and others has been submitted by Standard Power & Light Corporation. The proposal was filed last week with the District Court in Wilmington.

The suit for $100,000,000 was contemplated by minority stockholders, the Delevan Corporation of New Jersey and Emma A. Graham against directors of Standard Gas & Electric, H. M. Byllesby & Co., its officials and others. They sought recovery of assets for the corporation which they said "have been wasted, misapplied or misappropriated." Counsel representing the complainants recommended acceptance of the offer.

The proposed compromise is viewed as one of the first steps looking to a plan of reorganization of Standard Gas & Electric.

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Electric Units in Kentucky Consider Rural Power Rates

Representatives of privately owned utility concerns and rural electrification co-operatives met recently with the Kentucky Public Service Commission to consider a tentative rate schedule. The utility representatives stated that the companies have no desire to hinder development of co-operatives, as provided by the Legislature last year.

The commission gave the utilities two weeks to study the proposed schedule. It is expected that an amicable agreement will be reached.

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Norris Dam Model for Paris

A small-scale reproduction of Norris Dam will be exhibited by TVA this summer at the International Exposition in Paris. The model is being built by Paul Carlton of New York.

Consolidated Edison Seeking Steam Unit

Discussions looking toward the acquisition of the remaining common shares of New York Steam Corporation, an affiliate of Consolidated Edison Company, are under way between Edison officials and minority holders of common stock of the steam concern.

It is being proposed that one share of Consolidated Edison be exchanged for two shares of New York Steam. Consolidated Edison now owns about 75 per cent of the 360,000 outstanding common shares of New York Steam.

Consummation of such an exchange would pave the way for a refunding program of New York Steam and further corporate simplification of Consolidated Edison.

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Maryland Utility Extends Power Lines

Announcement has been made by Lewis Payne, new president and general manager of the Eastern Shore Public Service Company, that rural electric service is being extended in many sections of the Delmarva Peninsula.

The program, he said, will take electrical power along approximately 50 miles of rural roads and will make service available for a large number of farms which had been without electricity.

The company is rearranging transmission lines to Ocean City, Snow Hill and Millsboro areas in order to assure uninterrupted service. A section of transmission line between Greenwood and Harrington, in lower Delaware, is being relocated.

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Kentucky Utilities to Study System of Interconnections

Representatives of five utilities met with the recently created Kentucky Utilities Interconnections Committee to work out a program of interconnections, where such a step is feasible, to provide greater stability to service.

Subcommittees were appointed to determine feasibility of transmission line interconnections for companies operating in adjacent territories in the state.

REA Power Allotments Total $47,000,000

The Rural Electrification Administration has virtually completed allotting the $50,000,000 made available to it for the current fiscal year, with the exception of approximately $3,000,000 earmarked by the Rural Electrification Act for states which have lagged in asking for federal loans for rural projects. The REA will devote the next two and one-half months to complete preliminary work on projects to be financed after new funds become available on July 1 next.

The Norris Act that placed REA on a permanent footing authorizes, for the coming fiscal year, the appropriation of $40,000,000 for additional loans. Congress has not yet made the necessary appropriation, and the recommendation of the Budget Bureau submitted last January reduced this sum to $30,000,000.

There is a possibility that friends of rural electrification in Congress will attempt to restore the original figure, but in view of the current drive for economy it is more likely that the budget figure will stand, with the possibility of a deficiency appropriation early in 1938 should the $30,000,000 be used up by that time.

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Texas Utility Shareholders Favor Reorganization Plan

Shareholders of the Northern Texas Electric Company have been notified that the protective committee representing holders of its funded debt is heavily in favor of the reorganization which will be considered by the court on April 26. The committee represents 68 per cent of the collateral trust bonds and 78 per cent of the secured notes. On March 31 the company asked the court to authorize a reorganization of the company and its subsidiaries, the Northern Texas Traction Company and Texas Motorcoaches, Inc., under Section 77b of the Bankruptcy Act.

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Jersey Rural to Take Bids

The Sussex Rural Electric Co-operative will receive bids for labor and materials to be used in constructing a rural electrical distribution system. The bids will be opened April 30 at the Borough Hall, Sussex, N. J. Work being contracted by the co-operative covers construction of approximately 126 miles of a complete distribution system. It will have equipment necessary to connect these primary lines to primary lines of the New Jersey Power & Light Company, or a local plant at location to be designated. Construction will be financed by a loan from REA. The engineer is Louis T. Klauder of Philadelphia.

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Commission Denies Hydro Applications

Federal Power Commission has denied the applications for licenses filed by the Clarion River Power Company for two proposed power projects on the Clarion River in Pennsylvania, one known as the "Mill Creek project" and the other as the "Foxburg project," for which preliminary permits had been granted.

In denying the applications the commission found that the Foxburg project is contingent upon the Mill Creek project; that applicant has not submitted satisfactory evidence of compliance with the laws of Pennsylvania requiring licenses from the Water and Power Resources Board; that applicant has not included in its estimate of cost of Mill Creek project and has not shown what the effect would be upon the economic feasibility of said project of claims aggregating approximately $3,000,000, by property owners for damages for flooding of their properties in the event of construction of that project.

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Boston Edison Name Change Bill Signed by Gov. Hurley

Gov. Hurley of Massachusetts has signed a bill authorizing the Edison Electric Illuminating Company of Boston to change its name to the Boston Edison Company. Frank D. Comerford, president, petitioned the Legislature to approve the change some weeks ago on the ground that the expansion of the company's activities to embrace every phase of electrical energy supply transcended the limitations of a lighting organization's name.

It is anticipated that it will not be necessary to call in outstanding stock certificates or evidences of indebtedness held by the public, as the new corporation succeeds the former one.

Dealers Entertained by Florida Power

"Miami is probably the most prosperous section of the United States," said George Hughes, president of the Edison General Electric Appliance Corporation, when addressing approximately 300 electric dealers, guests of the Florida Power & Light Company, at a get-together dinner held at the Rod and Reel Club on Hibiscus Island. Mr. Hughes stated that salesmen must tell the story of the economy and comfort of electrical appliances. He said that when he first used an electric stove the rate was 30 cents; today in Coral Gables, it is less than 3 cents.

Henry Keele, residential sales manager Florida Power & Light Company, said that 4,000 new homes will be built in this area in 1937. "The electric appliance market for this community in 1937 will be $3,500,000, representing 14 810 major electric appliances," he continued. Bryan C. Hanks, president of Florida Power & Light, declared that electrical dealers and the utility company were partners in a great enterprise of public service, and that by co-operating the greatest sales in the history of the industry could be expected this year.

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Features Safety Poster

Wisconsin Public Service Corporation is sponsoring a safety campaign warning school children of the danger of flying kites near electric wires or using wire for kite string. A feature poster, showing the comic character "Popeye" cautioning youngsters against kite flying near electric wires, is being used. The poster has attracted unusual attention in the schools, clubs and other locations. A reproduction is currently appearing in all of the papers in the company's territory.

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N. Y. Utilities Lease Line

Lease of a transmission line in the towns of North Tonawanda, Wheatfield, Pendleton and Lockport, Niagara County, to the Niagara, Lockport & Ontario Power Company and the Buffalo Niagara Electric Corporation (formerly the Tonawanda Power Company) by the International Railway Company has been approved by the New York Public Service Commission.

Award Winners Named by Beaux Arts-I.E.S.

First prize of $300 in the Beaux Arts-Illuminating Engineering Society Prize Award was made to C. P. Andrade, student at the University of Pennsylvania, last week at a meeting of the New York section of the I.E.S. Second and third prize went to R. T. Daniels, Catholic University of America, and R. B. Little, University of Illinois.

Entrants were required to consider lighting as complementary to the architecture, rather than as an afterthought, said Otto Teegen, chairman of the Beaux Arts award committee. The problem was that of designing a room suitable for use as a convention hall, banquet hall and ballroom, with the lighting creating a different atmosphere for each of the three functions.

Built-in lighting was used almost exclusively by the 155 entrants, according to H. E. D'Andrade, chairman of the I.E.S. committee. All of the entrants made use of down lighting, 100 recommending ceiling units. Gaseous tube lighting, luminous walls and floors, fluorescent walls and polarized light were other suggestions of the contestants.

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Eastern Inspectors to Meet in Hartford

Plans are being laid for the annual meeting of the Eastern section of the International Association of Electrical Inspectors to be held September 27-30 in Hartford, Conn. A well-rounded program is being planned, with speakers of national prominence in the electrical industry included in the four days' activities.

Joseph P. Rohan, chief electrical inspector in the Hartford Building Department, has been named general chairman. An unusual amount of activity is being shown by all committees. Detailed information regarding the various meetings will be announced shortly by Mr. Rohan.

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Plan Lighting Conference

A conference devoted to the progress of lighting will be held May 10-14 at the General Electric Institute, Nela Park, Cleveland. The first three days of the session will be devoted to commercial and industrial lighting, while the remaining two will be devoted to highway and street lighting operation.

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Air Conditioning Meeting

The Air Conditioning Manufacturers' Association will hold its annual meeting May 14 and 15 at Hot Springs, Va., according to J. F. G. Miller, president. The association is planning a broad program of constructive work.

Meetings

Chamber of Commerce of the United States—Annual meeting, Washington, D. C., April 26-29.

Association of Iron and Steel Engineers—Spring meeting, Buffalo, N. Y., April 28-29. Brent Wiley, managing director, Empire Bldg., Pittsburgh, Pa.

Electrochemical Society—Spring meeting, Benjamin Franklin Hotel, Philadelphia, Pa., April 28-May 1. Colin G. Fink, secretary, Columbia University, New York, N. Y.

Edison Electric Institute—Annual technical committees, Chicago, May 3-7; annual meeting, Chicago, June 1-4. Bernard F. Weadock, managing director, 420 Lexington Avenue, New York.

American Institute of Electrical Engineers—Northeastern district, Buffalo, N. Y., May 5-7; summer convention, Milwaukee, Wis., June 21-25. H. H. Henline, national secretary, 33 West 39th St., New York, N. Y.

National Fire Protection Association—Meeting, Chicago, Ill., May 10-14. A. R. Small, 207 East Ohio Street, Chicago, Ill.

National Electrical Manufacturers Association—Spring meeting, The Homestead, Hot Springs, Va., May 16-20. W. J. Donald, managing director, 155 East 44th Street, New York, N. Y.

American Society of Mechanical Engineers—Semi-annual meeting, Detroit, Mich., May 17-21. C. E. Davies, national secretary, 29 West 39th St., New York.

Pacific Coast Electrical Association—Annual convention, Hotel Huntington, Pasadena, Calif., May 20-21.

National Electrical Wholesalers Association—Annual convention, The Homestead, Hot Springs, Va., May 23-27. Alfred Byers, secretary, National Electrical Wholesalers Association, 165 Broadway, New York, N. Y.

Southeastern Electric Exchange—Fourth annual conference, The Homestead, Hot Springs, Va., May 27-29. J. W. Talley, executive secretary, 308 Haas-Howell Building, Atlanta, Ga.

Economic Conference for Engineers—Seventh annual meeting, Stevens Institute of Technology Engineering Camp, Johnsonburg, N. J., June 18-26.

National Association of Credit Men—Annual convention, Hotel Stevens, Chicago, Ill., June 21-25.

Canadian Electrical Association—Annual convention, Banff Springs Hotel, Banff, Alberta, June 21-24. B. C. Fairchild, secretary, 804 Tramways Bldg., Montreal.

Chamber of Commerce Announces Program

A business consensus on important problems now confronting the country will be sought at the forthcoming annual meeting of the Chamber of Commerce of the United States, to be held in Washington April 26-29.

Among the many subjects listed for discussion are: labor relations in industry; flood control; effects of the tax on undistributed earnings; price-making in distribution.

Discussion at the meeting will center largely upon governmental policies in relation to business and the effects of existing and proposed legislation, together with the broad outlook for the future of business enterprise.

At the Round-Table Luncheon Conference, dealing with "National Conservation Policies," C. W. Kellogg, chairman Engineers Public Service Company, Inc., and president Edison Electric Institute, will make an address on "What Water Power Policy Does America Need?"

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E.E.I. Committees to Meet in Chicago

Engineering committees of the Edison Electric Institute will meet at the Edgewater Beach Hotel, Chicago, during the week of May 3. The electrical equipment committee will hold its sessions on May 3 and 4. The executive session on Monday morning will be for committee members only, but at the Monday afternoon session visitors will be welcome.

On Tuesday afternoon the electrical equipment committee will hold a joint session with the transmission and distribution committee, at which, among other subjects, "Drying Out and Rehabilitating Electrical Equipment Submerged by Flood," will be discussed.

The first session of the transmission and distribution committee will be held on Wednesday morning.

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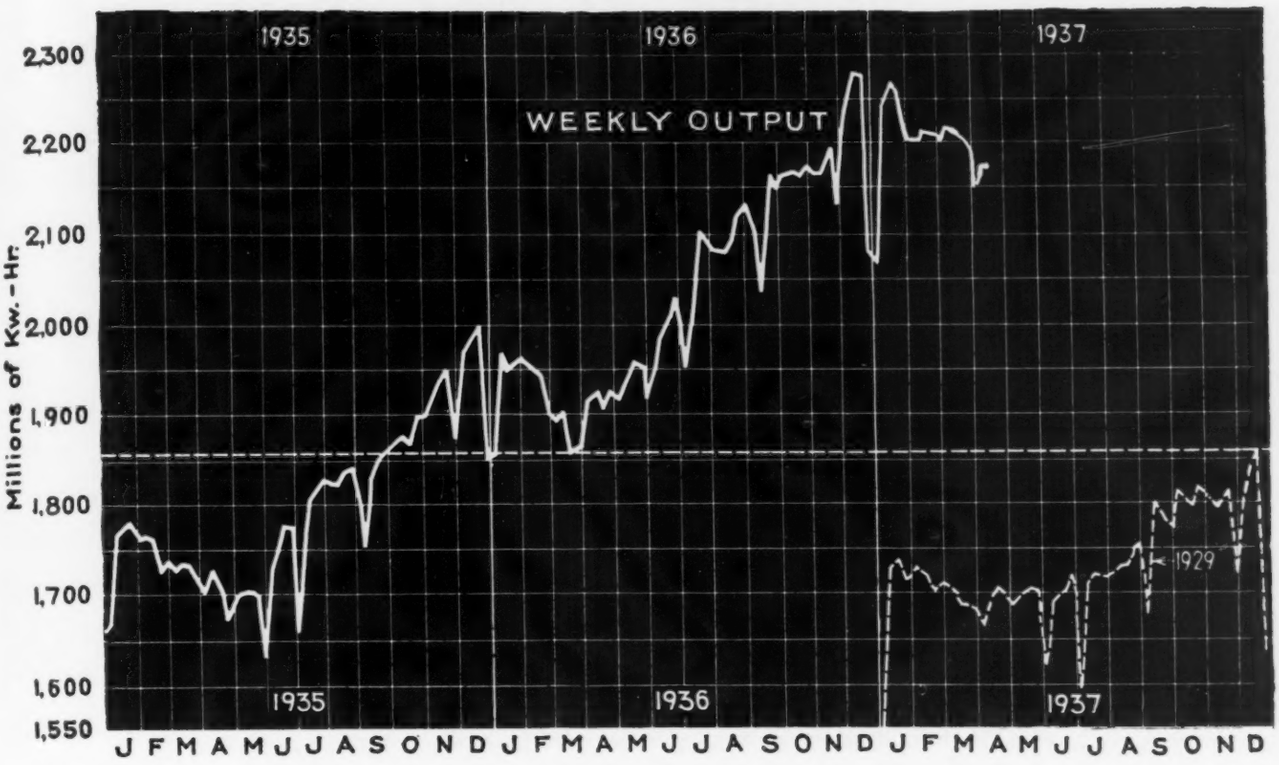
Refrigerating Group to Meet

The Refrigerating Machinery Association will meet May 12 and 13, at Hot Springs, Va., according to J. M. Fernald, president. The spring meeting will be devoted to discussions centering around the forward-looking standardization program which the association has undertaken.

Energy Output Maintains Its Level



Holding close to the preceding week's level, the output of the electric power and light industry during the week ended April 17 amounted to 2,173,223,000 kw.-hr. and surpassed that of the like period a year ago by 12.4 per cent, according to the Edison Electric Institute. The moderate recovery from the spring's low point of April 3 reported last week was maintained. The excess over 1936 reached its maximum in the latter part of March and has been gradually diminishing but is still as large as it was in the first half of February.

Regionally the greatest advance over last year is reported for the Rocky Mountain states where it reached the extraordinary figure of 37.5 per cent. The smallest was 4.1 per cent, in the Pacific states. The reasons were discussed in last week's issue. In other sections the gains indicated a week ago were maintained, being above 15 per cent in the South and Central industrial area and nearly as large in New England.

Weekly Output, Millions of Kw.-Hr.

1937	1936	1935
Apr. 17...2,173	Apr. 11..1,934	Apr. 10..1,725
Apr. 10...2,176	Apr. 4..1,916	Apr. 6..1,700
Apr. 3...2,147	Mar. 28..1,867	Mar. 30..1,713
Mar. 27...2,200	Mar. 21..1,862	Mar. 23..1,725
Mar. 20...2,211	Mar. 14..1,901	Mar. 16..1,728
Mar. 13...2,213	Mar. 7..1,893	Mar. 9..1,724

Per Cent Change from Previous Year

Region	Week ended Apr. 17	Apr. 10	Apr. 3
New England.....	+14.5	+14.4	+17.4
Middle Atlantic.....	+12.5	+11.4	+ 8.7
Central Industrial...	+15.5	+15.0	+16.8
West Central.....	+ 8.0	+ 8.0	+ 6.9
Southern States.....	+16.0	+14.5*	+ 7.9
Rocky Mountain....	+37.5	+30.1	+32.7
Pacific.....	+ 4.1	+ 5.6	+ 2.0
United States.....	+12.4	+13.6	+15.0

*Revised

Wisconsin Towns Ask REA Funds for Plant

Application for federal funds to build one large generating plant, with which to serve 6,200 customers, has been made by six rural electric co-operatives in western Wisconsin, according to John A. Becker, state REA director.

Allotments to construct lines have been obtained by the six co-operatives: Taylor County Electric Co-operative, $225,000 for 233 miles of line, for 899 customers; Chippewa Valley, $96,000, 60 miles, 301 customers; Buffalo county, $260,000, 264 miles, 794 customers; Trempealeau, $445,000, 424 miles, 1,273 customers; Clark county, $850,000, 674 miles, 2,400 customers; Barron county, $195,000, 145 miles, 708 customers.

With total allocations of $4,463,600 in REA funds to build more than 4,000 miles of rural line to serve about 14,400 customers, Wisconsin leads the country in its grants of earmarked funds, according to Becker.

•

Power Development Sought

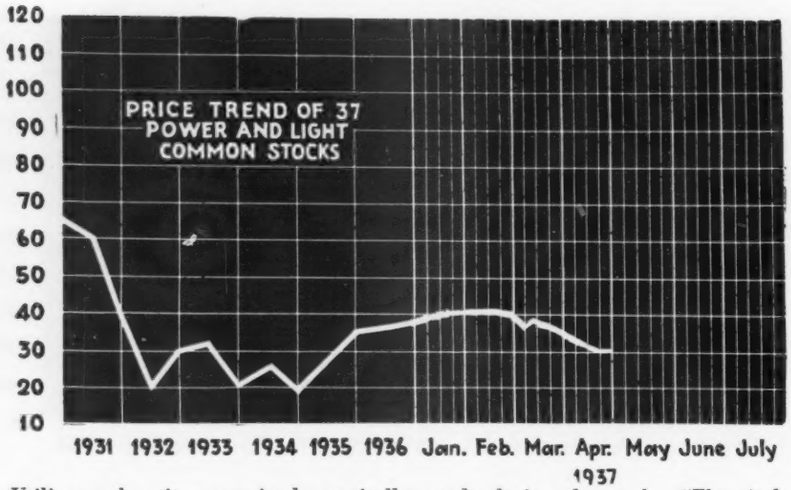
Application for permission to increase the power development of the Mersey Paper Company on the Mersey River, Nova Scotia, at a cost of $2,500,000, has been sought.

Electric Sales in Illinois

The total sales of electricity to ultimate consumers in Illinois in March, 1937, were 615,067,821 kw.-hr., as compared to 518,737,340 kw.-hr., in March, 1936, an increase of 18.6 per cent which practically equals the peak of 18.7 per cent established in September, 1936.

For the same period, the total sales outside of Chicago rose from 195,023,962 kw.-hr. to 245,158,221 kw.-hr., a 25.7 per cent increase, while the sales of the Commonwealth Edison Company advanced from 323,713,378 kw.-hr. to 369,909,600 kw.-hr., or 14.3 per cent, new peaks being established in both instances.

Utility Stock Prices Hold Level



Utility stock prices remained practically steady during the week. "Electrical World" index, 34.6; one week ago, 34.8; year's high, 41.5

McCarter Sees Gain In Utility Business

Visualizing a general moderate improvement in the earnings of Public Service Corporation of New Jersey, Thomas N. McCarter, president, told stockholders at the annual meeting this week in Newark that unless "we are up against a wave of radicalism which would swamp all of us, there is no danger of public ownership or competition from Federal sources." He said the company plans to simplify its corporate structure.

Mr. McCarter in replying to a statement at a meeting sponsored by the League for Industrial Democracy that New Jersey users of electricity paid $76,000,000 for it, while under TVA rates the bill would have been $37,000,000, said:

"There is no point in comparing Public Service rates and those of the TVA, because Public Service has no angel like the United States Government to pour in hundreds of millions of dollars, as is the case in the TVA." It was pointed out by Mr. McCarter that the company paid $20,000,000 in taxes, about one-sixth of its receipts, "while TVA pays no taxes at all."

Public Service is eager to obtain control of Jersey Central Power & Light Company, Mr. McCarter declared, but will not pay any "unjustified price."

•

To Retire Preferred Stocks

Announcement has been made by the General Public Service Corporation that it will receive proposals for the purchase, for retirement, of its $6 and $5.50 preferred stocks until April 30 at a price not in excess of $78 a share. A dividend of $1.50 a share on the $6 preferred and $1.37½ a share on the $5.50 preferred has been declared, payable May 1, 1937, to holders of record April 15.

•

Knapp-Monarch Plan Split

Stockholders of Knapp-Monarch Company will meet June 7 to vote on the proposed plan to split the common stock three for one. If the plan is approved 32,500 shares of the split stock would be underwritten for public offering after first being submitted to present stockholders. The common stock would be increased from 60,000 to 200,000 no-par shares. There are 38,085 now out-standing. Sales for the first quarter totaled approximately $715,000 and well ahead of a year ago.

•

Doherty Offer Protested

A protest has been filed in federal court by Benjamin J. Friedkass as a stockholder against the offer of Henry L. Doherty to settle a stockholders' suit against him and Cities Service Company interests. To end the action, which sought rescission of a $20,000,000 stock sale and an accounting of $80,000,000 alleged losses, Mr. Doherty offered $1,250,000 or 250,000 shares of Cities Service stock, to be turned over to the company.

The petitioner demanded that the compromise be spurned and that the court render judgment on the complaint. On March 16 stockholders of the company voted overwhelmingly for the acceptance of Mr. Doherty's offer.

•

Clarke Loses Post in Indiana Utility

Harley L. Clarke lost control recently of another unit in his once widespread utility holdings when H. T. Pritchard became president and chairman of the board of the Indianapolis Power & Light Company. Mr. Pritchard was re-elected president and was named to succeed Mr. Clarke as board chairman at the annual meeting of the company. Mr. Clarke has recently retired as chairman of the board of the Laclede Gas Light Company, St. Louis.

Fred B. Johnson, vice-president and general counsel, also was replaced. The board of directors was increased by the addition of P. C. Reilly, Wallace O. Lee, R. R. Monroe, Morris Feiwell and A. L. Jackson. The three last are directors of the Utilities Power & Light Corporation, which holds all voting stock in the Indianapolis utility.

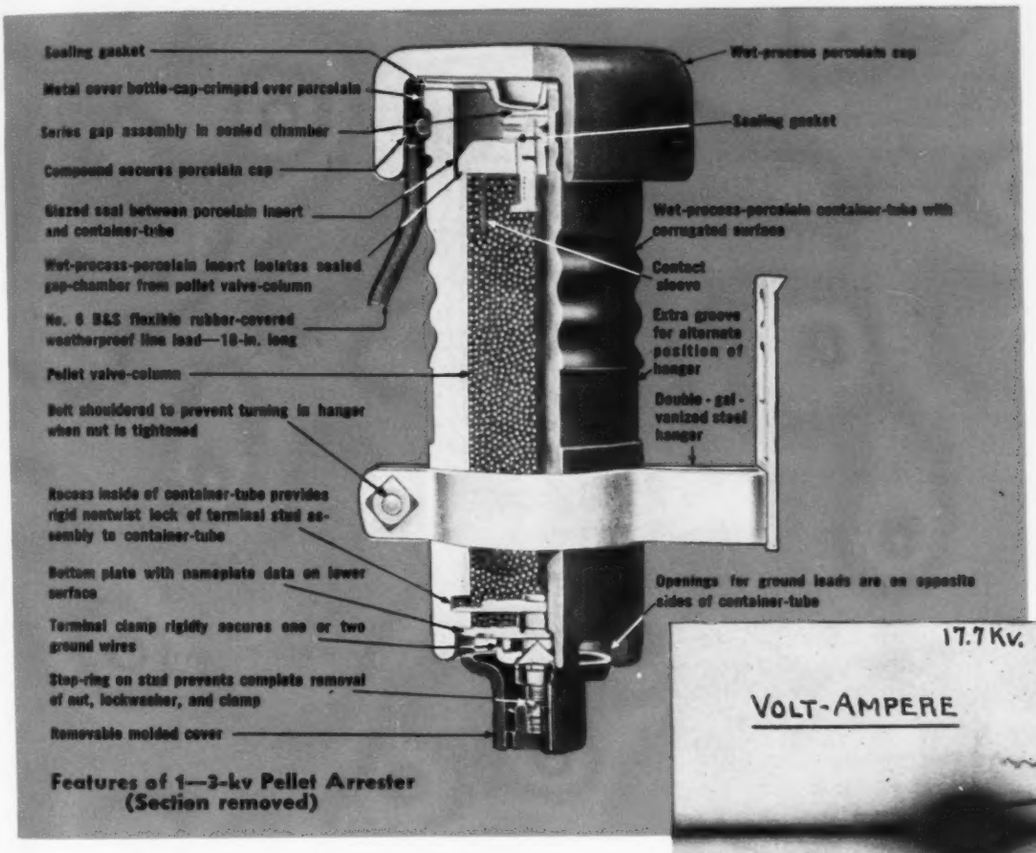
Another development in the affairs of Utilities Power & Light was the approval by Federal Judge William H. Holly of a request for $15,000 to finance an investigation of the company. Judge Holly recently appointed James L. Houghtling, a investment banker, to investigate the affairs of the corporation.

Utilities Earnings

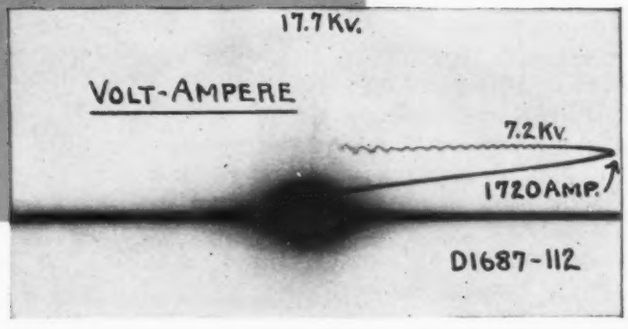
	Net Income 1937	1936
Blackstone Valley Gas & Elec.	$1,121,402	$1,046,886*
Central Maine Power	1,704,491	1,306,876*
Philadelphia Company and subs.	8,226,911	8,434,679*
Duquesne Light	10,314,413	10,547,153*
California Oregon Pwr	1,108,421	582,116*
Wisconsin Public Service and sub.	1,302,820	745,420*
San Diego Cons. Gas & Elec.	1,446,702	1,294,899*
Oklahoma Gas & Elec.	2,495,673	1,795,996*
Cons. Gas, Elec. Lt. & Pwr. Balt.	6,294,011	6,438,019*
Eastern Util. Assoc. and subs.	1,884,428	1,844,489†
Northern States Pwr. (Del.)	5,183,977	4,895,544†
Northern States Pwr. (Minn.) and subs.	4,980,508	4,617,834†
Kansas City Pwr. & Lt.	4,674,184	3,814,542*
Alabama Pwr.	3,783,418	3,065,189*

* Twelve mos. ended Feb. 28.
† Twelve mos. ended Jan. 31.

WHY You Should Specify G-E PELLET ARRESTERS


Sealing gasket
Metal cover bottle-cap-crimped over porcelain
Series gap assembly in sealed chamber
Compound secures porcelain cap
Glazed seal between porcelain insert and container-tube
Wet-process-porcelain insert isolates sealed gap-chamber from pellet valve-column
No. 6 B&S flexible rubber-covered weatherproof line lead—18-in. long
Pellet valve-column
Bolt shouldered to prevent turning in hanger when nut is tightened
Recess inside of container-tube provides rigid nontwist lock of terminal stud assembly to container-tube
Bottom plate with nameplate data on lower surface
Terminal clamp rigidly secures one or two ground wires
Step-ring on stud prevents complete removal of nut, lockwasher, and clamp
Removable molded cover
Wet-process porcelain cap
Sealing gasket
Wet-process-porcelain container-tube with corrugated surface
Contact sleeve
Extra groove for alternate position of hanger
Double-galvanized steel hanger
Openings for ground leads are on opposite sides of container-tube

Features of 1—3-kv Pellet Arrester (Section removed)



PROTECTION is the foremost consideration when you install distribution lightning arresters. G-E pellet arresters limit the lightning stresses on distribution systems to exceptionally low values. Note the accompanying cathode-ray oscillogram — a 1-3-kv pellet arrester, while passing a lightning discharge current of 1720 amperes, limits the lightning voltage to only 7.2-kv crest.

It is this extremely low voltage during current flow that distinguishes the performance of pellet arresters — and results in lower stresses on your distribution transformers.

This means *better protection*—a distinct benefit realized in more positive preservation of transformer insulation and in service continuity throughout severe lightning conditions.

G-E pellet arresters have been *proved* in service to have ample discharge current capabilities as determined by the *actual field measurements* of discharge currents in distribution arresters.*

Pellet arresters are backed by General Electric's outstanding lightning research and test facilities. They have a background of established service reliability involving approximately 14,000,000 arrester-years.

Where the greatest return on the dollar investment in distribution protection is desired, these facts all point to G-E pellet arresters as the best and most economical means of reducing lightning trouble on distribution circuits. For a complete description of these arresters, ask for Bulletin GEA-93L. General Electric Company, Schenectady, New York.

*(See AIEE 1935 transactions, page 1395; reprinted as G-E Bulletin GEA-2325.)

330-255

GENERAL ELECTRIC

Field OPERATING PRACTICES

New ideas and practices in the operation of well-designed, constructed and maintained plants and systems

Metal Spray Rebuilds Turbine Seal Rings

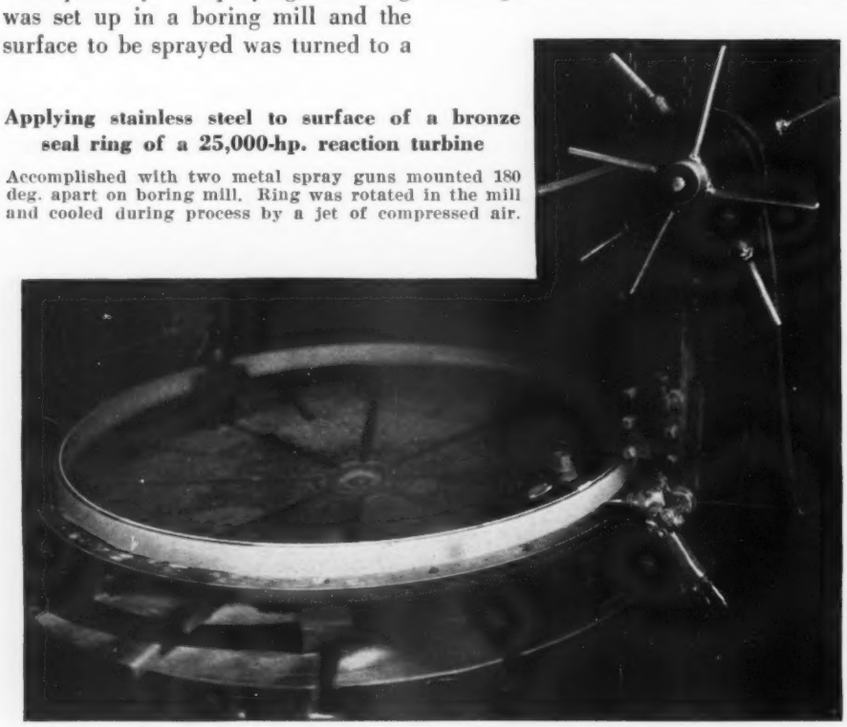
By T. C. STAVERT
Hydro Generation Department, Southern California Edison Company, Ltd.

Having used metal spray for various rebuilding jobs since 1932, Southern California Edison Company, Ltd., has accumulated a variety of experience in this method of repair. Recently metal spray was used to build up a worn stationary seal ring for a Pelton single-runner, vertical, Francis-type turbine rated at 25,000 hp. and operating under a static head of 800 ft. Repair required the deposit of 0.437 in. of sprayed metal on the diameter of a 60-in. bronze stationary ring having a face width of 3½ in.

Preparatory to spraying, the ring was set up in a boring mill and the surface to be sprayed was turned to a true circle. A 16 to 1 in. thread, 1/16 in. deep, was cut, to improve the bonding surface for the sprayed metal. Spraying followed immediately, using two model No. 81 "Metalspray" guns mounted with the spray nozzles 5 in. from the ring and separated 180 deg. on the circle, the ring rotating between the two spray guns.

First a 0.062-in. yellow brass coating was sprayed on. Brass was used for this portion of the rebuild because of its lower cost and because it sprayed on more rapidly than the stainless steel. Oxygen was supplied to the gun at 17 lb. pressure, acetylene at 15 lb. pressure and compressed air at 60 lb. pressure. No. 12 B & S gage wire was used. After two hours and five minutes of operation of the two guns the desired thickness of brass was obtained. With a minimum of delay, the spraying of the stainless steel was started over the brass. Three hours and twenty minutes later the two guns had deposited 0.156 in. of stainless steel on the ring, bringing the rings to the desired diameter, including the allowance of 1/32 in. to grind the sprayed metal to a true surface.

The maximum ring temperature reached during the spraying operation was approximately 220 deg. F. At this point a jet of compressed air was directed on the ring midway between the two spray nozzles, after which the temperature did not exceed 150 deg. A contraction of 0.017 in. on the diameter between the ring temperature immediately after spraying and the ring temperature at the room ambient was measured.



Applying stainless steel to surface of a bronze seal ring of a 25,000-hp. reaction turbine

Accomplished with two metal spray guns mounted 180 deg. apart on boring mill. Ring was rotated in the mill and cooled during process by a jet of compressed air.

Develops Device for Removing Pole Keys

By WALTER L. HOLLAND
El Cerrito, Calif.

An effective method for removing "jammed" keys was the outcome of difficulty encountered in removing the field poles from a 30,000-kva. synchronous condenser at Station G of the Pacific Gas & Electric Company, El Cerrito, Calif. Field poles were held in place by tapered keys, 7 ft. long and ⅝ in. wide tapered ⅞ in. to ¼ in., located in six keyways under each pole.

Work of removing the keys was started by using a piece of shafting 6 ft. long and 3 in. diameter as a ram to drive the keys out. Some, however, did not respond to this treat-

A SWITCH AND FUSE COMBINATION FOR SAFETY

When the switch is open, it's *wide* open—operators know they are safe. NEMA standard "open-gap" spacing for disconnecting switches.

When the fuse blows, the switch opens automatically—easy to spot from the ground—current leakage impossible, another safety feature.

Operators are safe when replacing fuses—they work from the ground—no climbing among hot lines.

Preferred by Outdoor-station Designers

This is the EF-2 drop-open fuse-disconnecting switch with our standard EG-1 high-voltage outdoor power fuse. Available for 6600- to 132,000-volt circuits. For more information, write your G-E office, or General Electric, Schenectady, N. Y.

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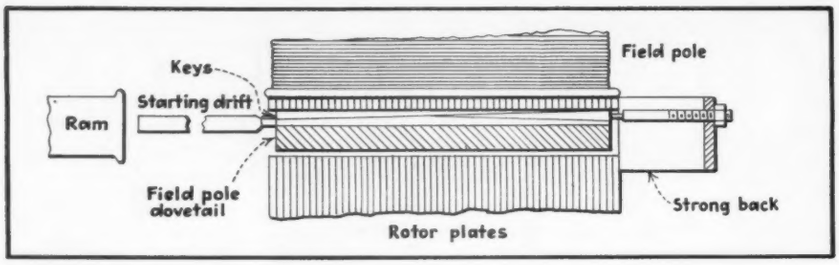
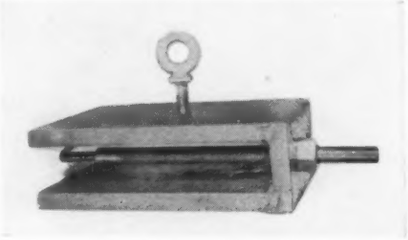
GENERAL ELECTRIC



Strong-back used for removing keys

The eyebolt is used to lash the device in place and hold it up when the key comes out.



ment. It was to remove these keys that a "strong-back" was built of ½-in. steel 12 in. x 3 in. x 8 in. to span the pole dovetail slot and keyway. The strong-back carried a ¾-in.-⅜-in. bolt which screwed into a ⅜-in. tapped hole in the large end of the key. With the strong back in place against the end rotor plate, the bolt was drawn as tight as possible. Thus a steady pull was maintained on the key while it was being driven with the ram.

The most stubborn keys were removed in this manner. In some instances keys were so battered and buckled on the small end that the key pair was driven and pulled out together.

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Pole Setting Depth Depends on Soil

By A. G. PERGANDE *
Distribution Engineer The Milwaukee Electric Railway & Light Company

Possibility of setting poles at depths depending upon the nature of the soil and the class of the pole without decreasing the stability of the line or its reliability offers opportunity to economize in rural line construction. The recommended depths, as listed in the Wisconsin State Electrical Code and the National Electrical Safety Code, are based on average soil conditions, and as no distinction is made between the various classes of poles in use at present, some poles may be set too shallow and others too deep for the type of soil. It is important that every foot of pole height be utilized in rural lines in order to take advantage of the increased span lengths made possible by increasing the portion of the pole above the ground line.

The Wisconsin State Electrical Code recommends a depth of 5½ feet for a 30-ft. pole. Tests show that the maximum strength of a class 6 pole will be developed when such a pole is set 4½ ft. in good soil, but in sandy soil it must be set 6½ ft. A 50-ft. class 1 pole should be set to a depth of 7 ft. according to the code and will develop its maximum strength when set at this depth in good soil, but if set in poor soil—that is, sandy soil—it must be set to a depth of 10 ft. before it will be possible to obtain the maximum strength of this pole.

In an article "Effect of Depth of Embedment on Pole Stability," by J. F. Seiler, engineer Service Bureau, American Wood Preservers Association, of November, 1932, the pole-setting depths given in the accompanying table are based on maximum pole strength for various types of soil and classes of poles.

A class 7 pole will develop its maximum strength at a setting depth of 9 in. less than the recommended depth of a class 5 pole and approximately 1 ft. less than a class 4 pole without loss of stability. It has been our experience over a period of many years that a depth of 5.50 ft. for class 4 poles does not result in leaning poles in poor or average soil, and it is, therefore, safe to assume that a 4.50-ft. depth of setting in good soil should not result in the loss of any stability in the line. This saving in depth will permit increasing the span length about 8 per cent without decreasing the ground clearance. The increased span length will not only reduce the cost of labor to set each pole but will reduce the number of poles per mile. This saving will amount to from $28 to $45 per mile.

* From paper to Wisconsin Utilities Association.

Depth Required for Maximum Pole Strength (30-Ft. Pole)

Soil	Class 7, Feet	Class 5, Feet	Class 4, Feet
Good to best.....	4.25	4.70	4.95
Average	4.75	5.50	5.80
Poor	6.00	6.75	7.20
Code requirement	5.50	5.50	5.50

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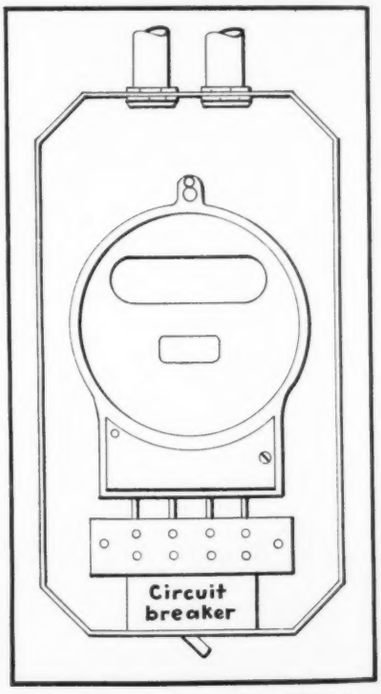
Circuit Breaker Also in Meter Box

Entrance point for rural service on the system of the Oklahoma Gas & Electric Company is the pole on the edge of the customer's property. The meter is installed in a standard aluminum diecast box mounted on this pole about 6 ft. from the ground. Contained in the same box is a 60-amp. circuit breaker of the type now coming into wide use for service entrances and branch circuits. The center knockout is removed from the bottom of the box and the operating handle of the breaker protrudes downward through it. The body of the breaker is behind, and is held in position by a masonite spacer and suitable metal straps which also serve as a mounting for the meter terminal block in the box.



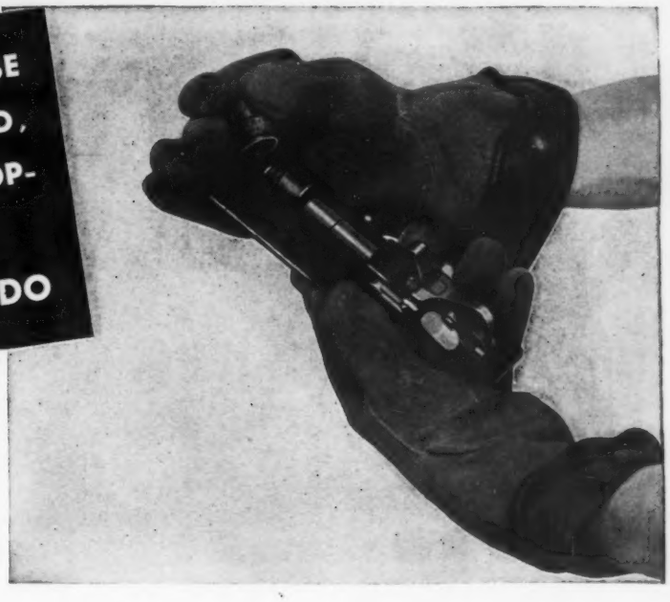
Room for service-entrance breaker made in meter box

This assembly provides a compact and easily operable service-entrance unit. It is low in cost and is perfectly satisfactory for the Oklahoma climate, which is fairly mild through the winter.

JUST THREE SIMPLE STEPS

TO RE-FUSE THE G-E 2 IN 1 CUTOUT

IT'S EASY TO RE-FUSE THE G-E ENCLOSED, INDICATING and DROP-OUT FUSE CUTOUT HERE'S ALL YOU DO



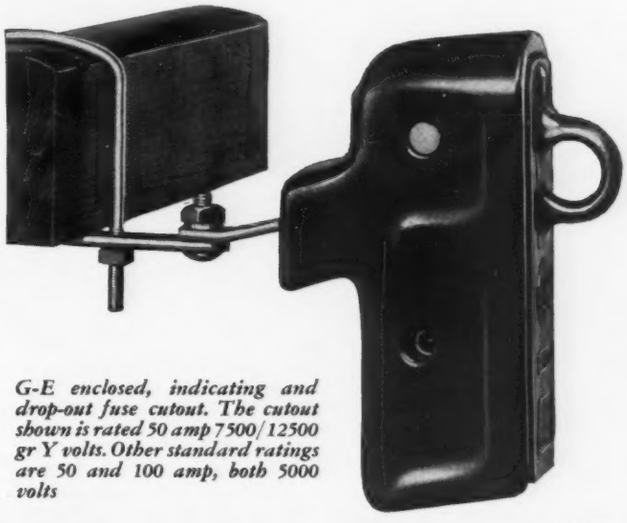
1 → Remove the door from the housing (when the door is open it is completely isolated from the circuit) and unscrew the cap from the fuseholder tube . .

2 . . . insert a universal cable-type fuse link . . .

3 . . . and wrap the cable around the clamping screw and pull it tight (only two fingers needed). Then tighten the screw and cut off any excess cable.

THESE three simple operations can be performed on the pole—better yet, as the doors are truly interchangeable, a spare door, fused on the ground, can be used. The ease of either method helps shorten the outage.

There's no need to waste time in making adjustments to obtain correct contact pressure, because, in G-E 2 in 1 cutouts, all contacts are accurately and permanently positioned, and the doors are perfectly interchangeable in all 5000- and 7500/12500-gr Y-volt ratings. These features assure you freedom from overheating and prevent unnecessary outages. For complete information, write for Bulletin GEA-1993C. General Electric, Schenectady, N. Y.



G-E enclosed, indicating and drop-out fuse cutout. The cutout shown is rated 50 amp 7500/12500 gr Y volts. Other standard ratings are 50 and 100 amp, both 5000 volts

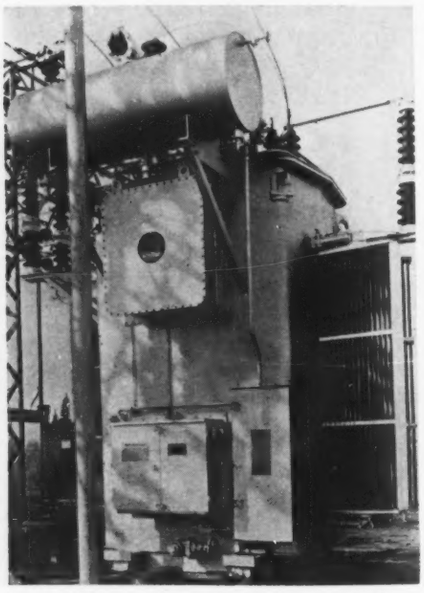
340-28

GENERAL ELECTRIC

Regulate Distribution for Best Efficiency

By THEODORE BAATEN
Central Station Division, Westinghouse Electric & Manufacturing Company

Investigation of several small distribution systems by the writer revealed that a regulation of 25 per cent, or even more, on the various feeders was not at all uncommon. When one considers that a large pro-



Step voltage regulator in large switching station saves about $8,000 annually

Three generating plants are connected by 132-kv. lines and a small obsolete steam plant by a pair of 24-kv. lines. The regulator changes taps automatically and keeps the feeder voltage constant at all loads, making it possible to discontinue the use of the steam plant except in emergencies, with resulting savings.

portion of this load is for lighting and ranges, where the amount of energy drawn from the circuit with a given connected capacity varies as the square of the voltage, it is apparent that improved voltage regulation is a desirable goal from the standpoint of the utility as well as of the consumer. With the new equipment which has been made available during the last few years this improved voltage regulation is made possible at a minimum of expense and inconvenience.

One of the systems investigated has a single generating station with three outgoing 2,300-volt, three-phase, 60-cycle radial feeders. It was found that by transferring three transformers and a short tap circuit near the station from one of these feeders to the other two induction voltage regulators located at the station would satisfactorily regulate this feeder. On the two other feeders it was found advisable to install regulators at some distance from the station. Two regulators were required for each circuit of the type which can be mounted on adjacent poles without any interconnection of control leads. They are fully automatic and provide a smooth change of voltage over a range of —10 per cent to +10 per cent.

One of the circuits branched off into a "shoestring" feeder several miles in length, and it was found advisable to install boosters on this branch, which automatically provide an additional 10 per cent boost in two steps.

On another system which was investigated it was found that by making an investment of some $1,100 in wire, line material and switching equipment to change the existing distribution from single to three-phase a yearly saving of around $700 could be made.

A third utility found that by installing induction regulators at its two substations on all the feeders and two-step boosters at proper points along the feeders it was able to keep its over-all voltage range within very close limits even with an appreciable increase in load.

It is simple to spot the loads along the various feeders and calculate approximate voltage drops to different points. Voltage charts should also be taken for 24-hour periods, or longer, at a number of locations. With all data accumulated, it is then simply a matter of selecting the proper corrective equipment for one's particular needs and perhaps increasing copper sizes at certain points.

•

Company Salvages 8- to 12-Year Poles

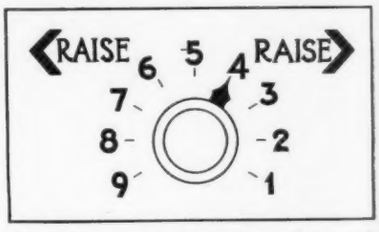
The Orell division of the Louisville & Interurban Railway recently salvaged 510 creosoted pine poles which had been in service from eight to twelve years. Of these 504 were 30 ft. and 6 were 35 ft. long. Part had been treated with 8 lb. and part with 10 lb. of creosote per cubic foot final retention. Upon removal, C. O. Seaton, superintendent of power distribution for this company, states that eight were found to have deteriorated because of attack by woodpeckers and termites, to a point where they could not be used again. The apparent cause of these attacks was excessive checking, which extended into the untreated part of the pole. The remaining 502 poles were in excellent condition and will be installed for further service.

In addition to the usual method of raising these poles by jacks, a winch with an A-frame "back" was used where the terrain would permit, contributing to the economy of the salvage work. It was found possible to remove the poles and haul them an average distance of 10 miles to the pole yard at a cost of less than $1 per pole, according to Mr. Seaton in an article in *Wood Preserving News*, from which this item was adapted.

•

Tap Setting Shown On System Board

Between two parts of the Oklahoma Gas & Electric Company system there is installed a one to one ratio autotransformer with taps for balancing voltage and determining the amount of energy flow from one to the other part. The setting of the taps on this transformer is under the control of the system operator and, of course,



System operator keeps visual record of tap changes

he must know at all times what it is. The written log record of tap changes is supplemented by a graphic device on the system board which shows the operator at a glance just what the setting is. It is thus not necessary for him to refer to the log or any other record at a time when he might want to know what the tap setting on the balancing transformer happens to be. The device is a radio control knob, mounted on the operating board at the place indicated by the location of the balancing transformer in the system. The transformer has nine taps, four steps of 2½ per cent each above and below the center tap. The taps are numbered from one to nine in the circular scale around the knob on the board and the direction of the pointer indicates voltage raise to either side of the system according to the tap setting which has been made.

MORE THAN EVER BEFORE—CONTINUITY COUNTS

THE NEW LOADS THAT ELECTRIC SERVICE IS ATTRACTING demand greater continuity than ever before. The high quality of the service, and the equipment that provides it, have never been more important. That is why we call your attention to the excellent operating record of G-E distribution transformers, indicating as it does the highest degree of reliability and overall economy. General Electric Company, Schenectady, N. Y.

300-53

GENERAL ELECTRIC

Industrial ELECTRIFICATION

New ideas and practices in industrial electrification as presented by industrial, consulting and power sales engineers

Undercutting Mica on D.C. Commutators

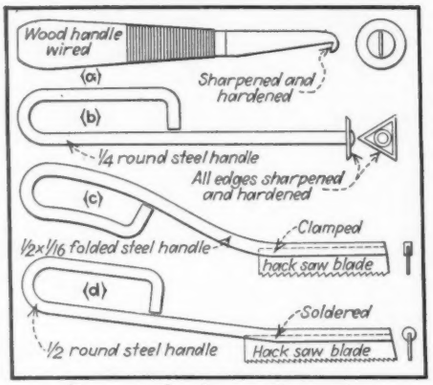
By JOHN S. DEAN

Engineering Division, Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

Noticeable improvement of the operation of d.c. electrical machines brought about by the undercutting of the mica on the commutators has demonstrated to electrical maintenance engineers the value of this procedure as a means toward better maintenance. In general, the object of this operation is to remove the mica between the copper bars or segments from the commutator, to enable the brushes to ride more smoothly over the brush track on the face of the commutator.

In connection with this work the following suggestions are made to insure a more dependable job:

1. The mica should be undercut to a depth of $\frac{1}{32}$ to $\frac{1}{16}$ of an inch.
2. Use a saw that is equal to, or preferably 0.003 in. larger than, the thickness of the mica to be undercut.
3. Experience has shown that a saw with about 20 teeth gives the best results. Using a greater number of teeth, for example 40, the saw will tend to clog. Also, one with less teeth, say about 12, will produce a rough cut in the slot.
4. The diameter of the saw should be between ¾ and 1½ in. If the diameter is too large the saw will cut into the neck of the commutator.
5. The best cutting speed for the saw is around 2000 revolutions per minute.
6. Use saws made from high-speed steel as they are less expensive in the end. Plain carbon steel saws dull quickly and then make a rough, uneven slot.
7. Clean-cut rectangular slots are preferable to the "V-shaped" ones which are not the correct uniform depth. Also, they leave some of the mica on the sides near the top, which is dangerous.
8. Carefully inspect all undercut slots and remove any mica slivers left on the sides. This is essential as these particles of mica may cause the brushes to spark.
9. When brush sparking starts due to poor undercutting, it tends to produce rough spots and flat bars on the commutator, and these further aggravate sparking, resulting in poor commutation.
10. To insure slots free from mica slivers it is necessary to do some hand work after the machining operation. This can best be done using tools similar to those shown.
11. On certain types of machines it is advisable to break or round the sharp corners left on the copper bars after the undercutting, further to improve their commutation.
12. Finally, smooth and polish the face of the commutator, using fine sandpaper. Under no condition use emery paper for this work.



Four tools for undercutting commutator mica

•

Heat-Treat Oils in Electrified Kettle

By JAMES C. HARRIS

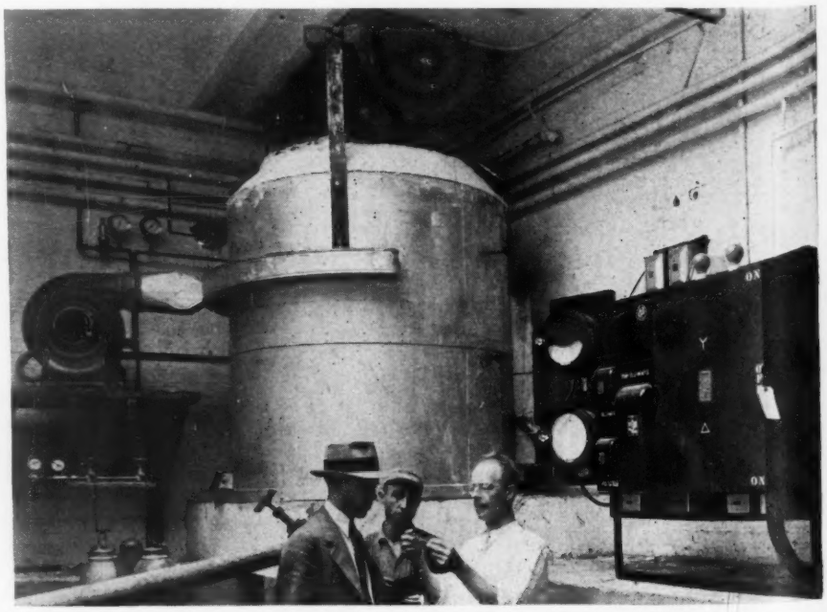
Industrial Power Department
Consolidated Gas, Electric Light & Power Company of Baltimore

and GEORGE SUTHERLAND

Harsumo Company, Baltimore, Md.

Improved product quality and lower production cost have resulted from the installation, at the Baltimore plant of the H. B. Davis Company, of an electrically heated kettle for heat-treating linseed and other oils under a controlled atmosphere of carbon dioxide.

Formerly cooking of oils was done



Electrically heated kettle heat-treats linseed oil in controlled atmosphere

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Try it for two weeks! You'll find it safe and accurate in measuring current in A.C. conductors and bus bars. You'll like its convenient single-hand operation, leaving the other hand absolutely free. By means of the dual range feature a simple turn of the self-contained switch immediately changes the range of the instrument.

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This instrument instantly and accurately indicates the current flowing in a bare or insulated conductor—merely clip the frame around the conductor. With this instrument the balance can immediately be determined in 3-wire systems or 3-phase circuits. Loads on feeders, switches, motors, transformers, can be accurately checked. Multitudes of other readings can be readily taken.

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Beauticians Use Welded Equipment

Lincoln Electric Co.

(a) Permanent wave machine welded from 20 gage stock. Similarly duct work, hoppers, bins, metal cabinets, door and window casings, etc., can be fabricated in as thin as 24 gage stock if desired. (b) Fabricating metal chair frame of 16 gage steel

in open kettles over a flame. Temperatures of 550 to 600 deg. F. were maintained for a period of time necessary to produce the desired viscosity. Use of the electrically heated kettle in addition to reducing labor costs makes possible a reduction in the losses due to evaporation of the oil and provides a certain degree of control over acidity of the product.

The apparatus consists of a monel metal kettle, approximately 300 gal. capacity heated externally with 55 kw. of oven type heaters. Into the top of this kettle is introduced (1) an agitator powered by a ¾-hp. motor, (2) a gas vent that discharges through an oil seal, (3) an additional vent to which is attached a suction fan powered with a 5-hp. motor, (4) a carbon dioxide inlet and (5) a manifold for introducing the next charge of oil. On the outside of this kettle is connected a manifold for introducing air which is used to cool the outside of the kettle.

Temperature of the charge is controlled by two thermostats, one limiting the temperature of the outside heating chamber and the other limiting the temperature of the oil which is being treated. This second thermostat is a two-point controller which turns on the cooling blower, driven by a 3-hp. motor, when the temperature of the oil exceeds by 5 deg. the temperature set on the thermostat. This control is necessary due to the oil generating exothermic heat after it has reached a certain temperature.

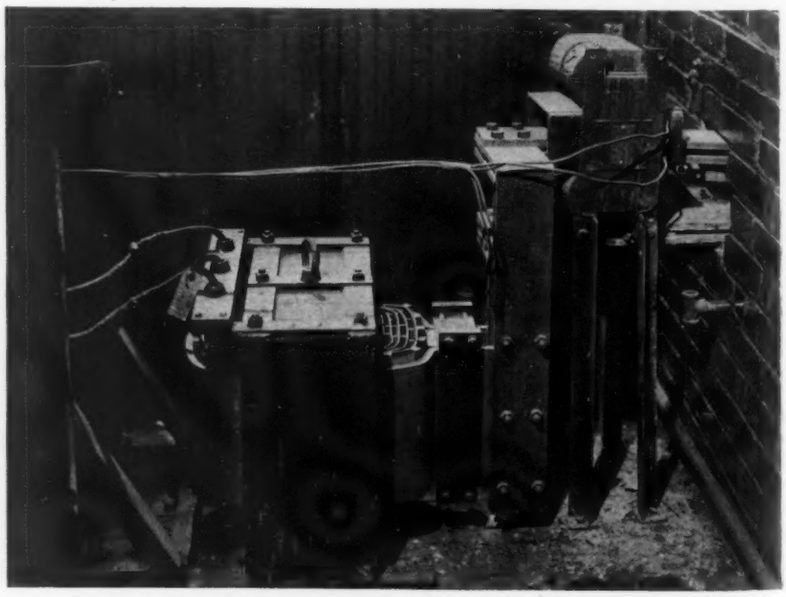
Equipment for bleeding off fumes and excess CO_2 is located outside the buildings. A 2-hp. transfer pump is also part of the equipment for this installation. According to *Electric Heat*, a publication of the Consolidated Gas, Electric Light & Power Company of Baltimore, from which the accompanying illustration was taken, this installation consumes 0.7 to 0.9 kw.-hr. per gallon of finished product.

•

Alternating Currents Agitate Solution

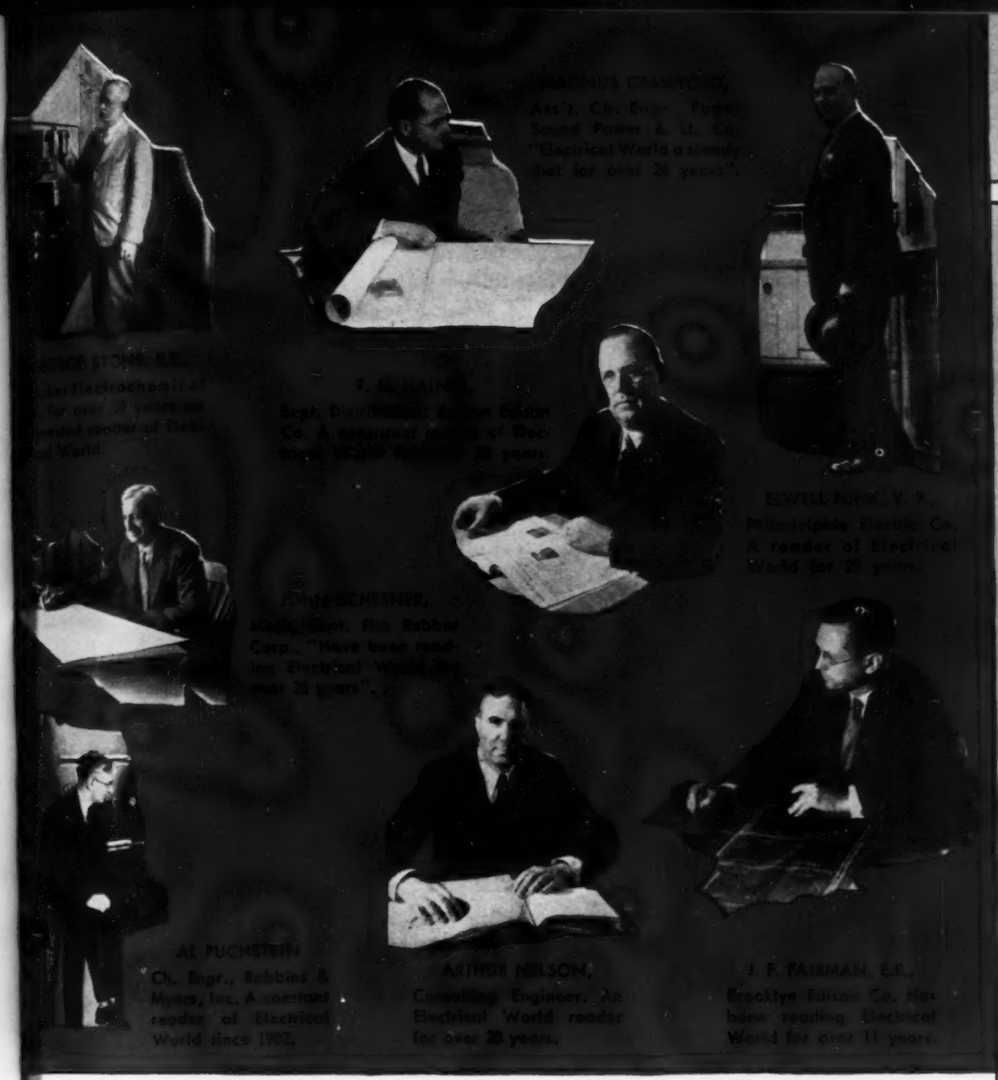
For cleaning scale from gear blanks as they come from the forging presses by way of "straight-through" heat-treating furnaces, a long tank of pickling solution is used in the forge shop of the Chevrolet Motor Company plant at Muncie, Ind. The gear blanks are loaded into conveyor baskets which move slowly along through the hot cleaning solution. The conveyor chain, to which the baskets are attached, is connected, through its supporting structure, to one side of a low-voltage, high-current transformer secondary. The other side of the secondary is connected to a series of graphite plates, hung in the solution along the sides of the tank.

The transformer is rated at 40 kva.; secondary potential is 6 volts. About 7,000 amp. is thus carried through the cleaning solution between the two electrodes constituted by the baskets filled with gear blanks and the submerged graphite plates. When the current is turned on in the pickling tank the solution becomes agitated, bubbling vigorously. And most important, because it is the useful result, the scale on the gear blanks drops off with a most remarkable alacrity.



Output of heavy current transformer agitates solution

Note the single turn secondary, its ends bolted to the busbars leading to the load. Primary is 440 volts and capacity is 40 kva.



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New ENGINEERING IDEAS

Discoveries, proposals and developments by electrical engineers and scientists in the field, the factory and the laboratory

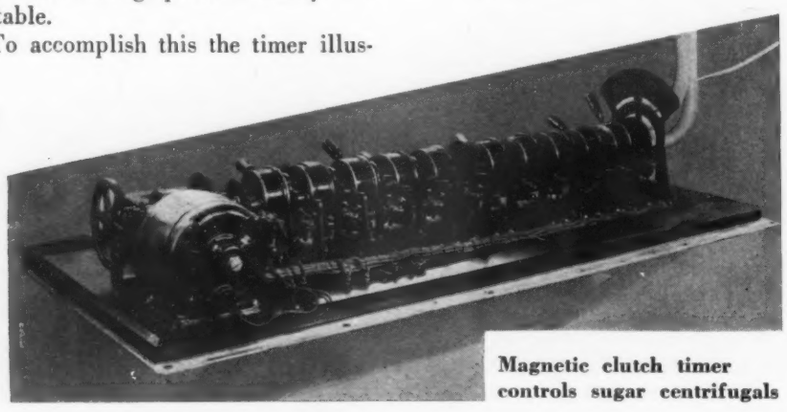
Centrifugals Timed by Magnetic Clutch

By H. A. DELIUS
California & Hawaiian Sugar Refining Corporation, Ltd., Crockett, Calif.

In the refining of cane sugar there are many operations which require accurate timing to secure the desired uniformity in the quality of the product produced. One of these is to time accurately the spinning period of a battery of ten belt-driven centrifugals processing brown sugar. These machines are manually operated and therefore it was necessary to provide a method of notifying the operator by means of a warning horn and signal light when the sugar had been spun long enough to give it the desired quality. As the proper spinning time differs for the different grades of brown sugar, it was also necessary to have the timing period readily adjustable.

To accomplish this the timer illustrated was developed. Detailed description of the operation is contained in the caption of the accompanying illustration, but the timer consists essentially of ten small magnetic clutches each carrying a weighted arm and tripping finger. The tripping finger engages a mercury switch energizing the alarm for that particular machine. When the machine is stopped the counterweight pulls the magnetic switch back into its original position in readiness for another cycle.

Each magnetic clutch is controlled by a mercury switch mounted on the clutch-operating lever of the individual centrifugal machines. When the operator throws in the clutch to start the loaded basket to spinning the mercury switch establishes contact, energizing the magnetic clutch of the unit involved. When the timing period for this machine is completed the tripping arm trips the mercury switch in the instrument. When this occurs a gong sounds and the red signal light for the centrifugal in question is illuminated, notifying the operator that the spinning period has been completed and that the centrifugal should be shut down.



Magnetic clutch timer controls sugar centrifugals

Magnetic clutch consists of a long central shaft driven at constant speed of one revolution per hour by a fractional-horsepower synchronous gear motor. On this shaft are fastened ten small magnetic clutches, the armatures of which are free to rotate on the shaft. Each armature carries a weighted arm and tripping finger. When the magnetic clutches are de-energized the weighted arm rotates the disk backward until the latter comes to rest against an adjustable stop. In front of each clutch is a mercury switch tripped by the tripping finger on the armature. The position of all mercury switches is the same, so the timing period is the same for all units and is the time required for the armature disk to rotate at the rate of one revolution per hour from its stopped position to a point where the tripping finger actuates the mercury switch. A pointer and scale at the right-hand end of the timer gives a visual indication of the timing period for which the stop is set.

•

Furnace Regulation Simplifies Operation

A system of completely automatic regulation employed in an electric furnace installation at Jeumont, France, is characterized by the *Electrician* (London) as increasing the simplicity of operation, preventing accidents and avoiding the necessity of periodic overhauls and cleaning.

The furnace is of the Heroult type, has a capacity of 3 to 4 tons and is used in the production of special brass. The two rolling sectors, on which the furnace rests, permit it to be tipped in either direction by electrically controlled jacks, controls being located on either side of the furnace.

Three generators feeding the motors that regulate the electrodes are placed in a substation on a single shaft turned by an asynchronous motor. These generators are excited by two independently opposed windings which are fed by rectified currents proportional respectively to the voltage at the connections of the arc and to the current. For a given value of these, as provided at the controls, the electrode is at rest. Direction of rotation of the motors controlling the electrodes is such that in the case of excess current and low voltage—arc too short—the corresponding electrode is raised; in case of excess voltage and low current, the electrode is lowered.

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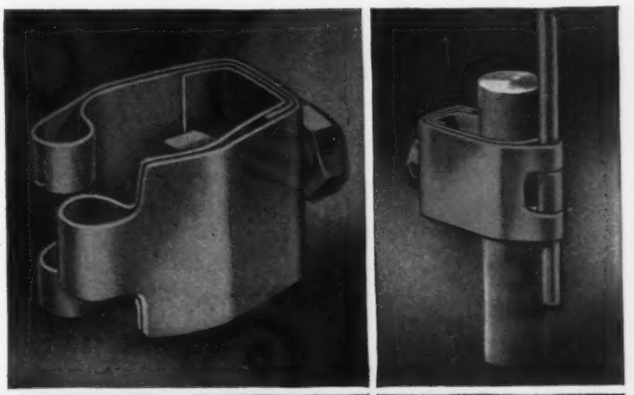
FEATURES OF THE CLAMP-TITE

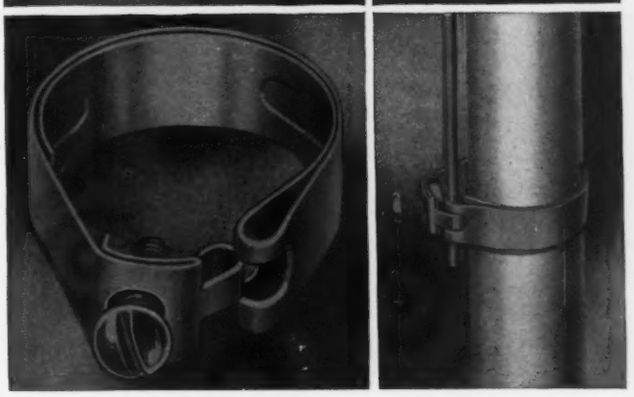
FOR GROUNDING TO ROD →

At a glance you can see that the principle of design of this ground clamp is right. The "strap construction" permits the clamp to conform to the conductor and to the rod or pipe as well. Naturally this provides maximum contact surface — the very thing you want.



FOR GROUNDING TO PIPE →

The Clamp-Tites for pipe incorporate the same principle of "wrap construction" and have similar advantages of quick installation or removal; positive holding power even under conditions of expansion or contraction; and assurance that contacts will not burn away under heavy discharges to ground are additional features of this clamp.



VARIETY OF SIZES *Clamp-Tites are available in a variety of sizes and applicable to either stranded or solid conductors.*

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T CON-NEC-TITES;
LAP TITE CONNECTORS;
TRIP OUT FUSE SWITCHES;
TRIP-O-LINK FUSE SWITCHES;
TRIP-SAVER FUSE SWITCHES;
ONE AND TWO INSULATOR FUSE AND DISCONNECT SWITCHES;
PORCELAIN HOUSED TRIPOMATIC FUSE CUTOUTS;
DOUBLE DUTY FUSE CUTOUTS;
POLE TOP GANG OPERATED SWITCHES;
PORCELAIN HOUSED DISCONNECT SWITCHES;
N. E. M. A. HOOK OPERATED DISCONNECT SWITCHES;
FUSE LINKS;
FUSE LINK BOXES;
FUSE PULLERS;
SECONDARY FUSES;
SCREW ANCHORS;
EXPANSION ANCHORS;
FULL-YU GUY GUARDS;
GUY WIRE CLIPS AND STRAND BANDS;
ECONOMY CABLE CLAMPS;
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FACTORIES AT ST. LOUIS, MO., TORONTO, CANADA

Automatic Oscillo Anticipates Faults

By JEFFERSON S. De SHAZO
Field Engineer, Test Department
Pennsylvania Power & Light Company
Hazleton, Pa.

Modern high-speed protective equipment has made still higher speed initiation of automatic oscillographs desirable. Only ½ cycle of record may be lost if use is made of expensive and complicated starting equipment. However, this speed of initiation varies considerably and at best it is still necessary to estimate the unknown portion of the transient which occurs before the start of the record.

This uncertainty has been eliminated through the use of a device recently applied to automatic oscillographs on the system of the Pennsylvania Power & Light Co. Energy of the transient is stored as an acoustic wave traveling through the air contained in a coiled rubber tube. The length of this tube governs the time required for the wave to arrive at the receiving end and thus controls the delay obtained. This energy is then reconverted into alternating current and released to an element of the oscillograph after its initiating relays have had sufficient time to function. By referring to Fig. 1 this operation may be followed. All parts of the oscillograph as well as the delay device are static and de-energized until the occurrence of a fault. Starting from rest after the transient begins, the record is then made of conditions leading up to and existing before the fault occurred. The equipment used is simple, rugged and inexpensive.

The oscillogram reproduced in Fig. 2(a) shows ground current, recorded on the fourth element, which has been stored and delayed for 8 cycles. The sixth element of Fig. 2(b) has 6 cycles delay.

The sudden displacement from its zero position shown on the fourth element of oscillogram Fig. 2(b) is a trip signal showing the point at which control current is applied to the opening coil of an oil circuit breaker. This indication is obtained from the secondary of a current transformer connected in the d.c. circuit supplying the station relay bell bus. It correlates each successive oscillogram with the accompanying circuit breaker operation and separates the time in cycles required for the relay to close contacts from the time required for the circuit breaker to part contacts and extinguish the arc.

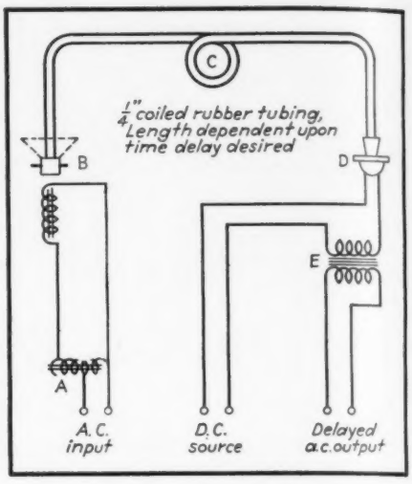


Fig. 1—Operation of delay device

Low voltage a.c. input "A" obtained from current or potential transformer is applied to coil of magnetic speaker "B." Mouth of unit B is attached to one end of coiled rubber tube "C," while the other end is connected to microphone "D."

The same battery and relay operating the oscillograph also energizes this microphone. Direct current is then drained off through transformer "E," leaving only the delayed a.c. wave.

Knowledge of the cause and time required for each relay operation has aided greatly in the analysis of their operations and the elimination of certain troubles occurring in older types of relays such as rebound of the relay disc and slow opening of the overcurrent contacts used with directional relays. Incorrect operation of balance ground current relays was traced to the high mutual coupling for zero sequence currents which exists between three or more parallel circuits.

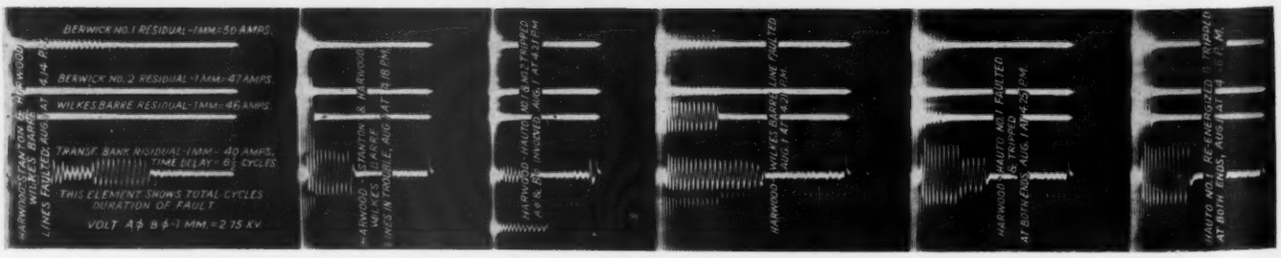
An accurate count of the total cycles duration of each fault enables us to match oscillograms made simultaneously at different substations and thus facilitates location of the point of fault.

SIEGFRIED SUBSTATION
DATE 7-11-36 TIME 7.52 P.M. TRIPOUT NO.16
28 KV.-M.M. POSITIVE SEQUENCE VOLTS 66 KV. BUS
80 AMPS.-M.M. S.R.Y-Φ AMPS.
57 A.-MM. S.R. RESIDUAL AMPS.
128 A.-M.M. BUS DIFF. NO.1 WEST RESID. AMPS. & 220 KV. TRIP INDICATION
135 A.-M.M. S.R.X-Φ AMPS.
RESID. TRANS. BANKS DELAYED ELEMENT
54 A.-M.M. RESID. AMPS. 220 KV. TRANS. BANKS
100 A.-MM. S.R.W-Φ AMPS.
100 A.-MM. SIEG. FREE NO.3 RESID. AMPS.
RELAY TIME 6 CYCLES O.C.B. TIME 27 CYCLES
FAULT DURATION 33 CYCLES

Fig. 2b (above).

SIEGFRIED SUBSTATION
DATE 7-13-36 7.24 P.M. TRIPOUT NO.17
2.8 KV.-M.M. POSITIVE SEQUENCE VOLTS 66 KV. BUS
80 AMPS.-M.M. S.R.Y-Φ AMPS.
57 A.-MM. S.R. RESIDUAL AMPS.
128 A.-MM. BUS DIFF. NO.1 WEST RESID. AMPS. & 220 KV. TRIP INDICATION
135 A.-MM. S.R.X-Φ AMPS.
RESID. TRANS. BANKS DELAYED ELEMENT
54 A.-M.M. RESID. AMPS. 220 KV. TRANS. BANKS
100 A.-MM. S.R.W-Φ AMPS.
100 A.-MM. SIEG-FREE NO.3 RESID. AMPS.
RELAY TIME 6 CYCLES O.C.B. TIME 26 CYCLES
FAULT DURATION 32 CYCLES

Fig. 2a (below).


BERWICK NO.1 RESIDUAL-1MM=50 AMPS.
BERWICK NO.2 RESIDUAL-1MM=47 AMPS.
WILKES BARRE RESIDUAL-1MM=46 AMPS.
TRANSF. BANK RESIDUAL-1MM-40 AMPS. TIME DELAY=6½ CYCLES
THIS ELEMENT SHOWS TOTAL CYCLES DURATION OF FAULT
VOLT A-Φ B-Φ-1 MM.=2.75 KV.

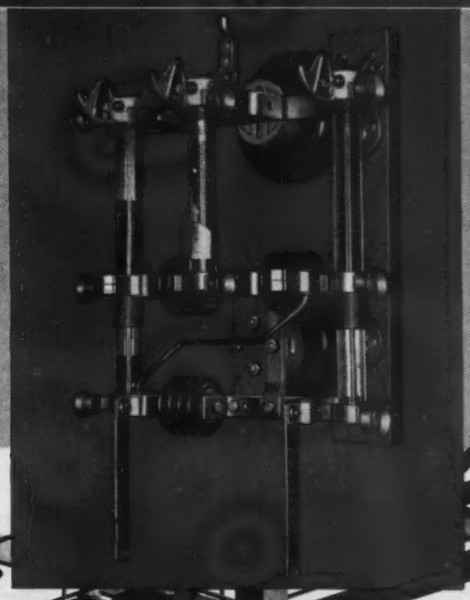
Successive events displayed by oscillograms

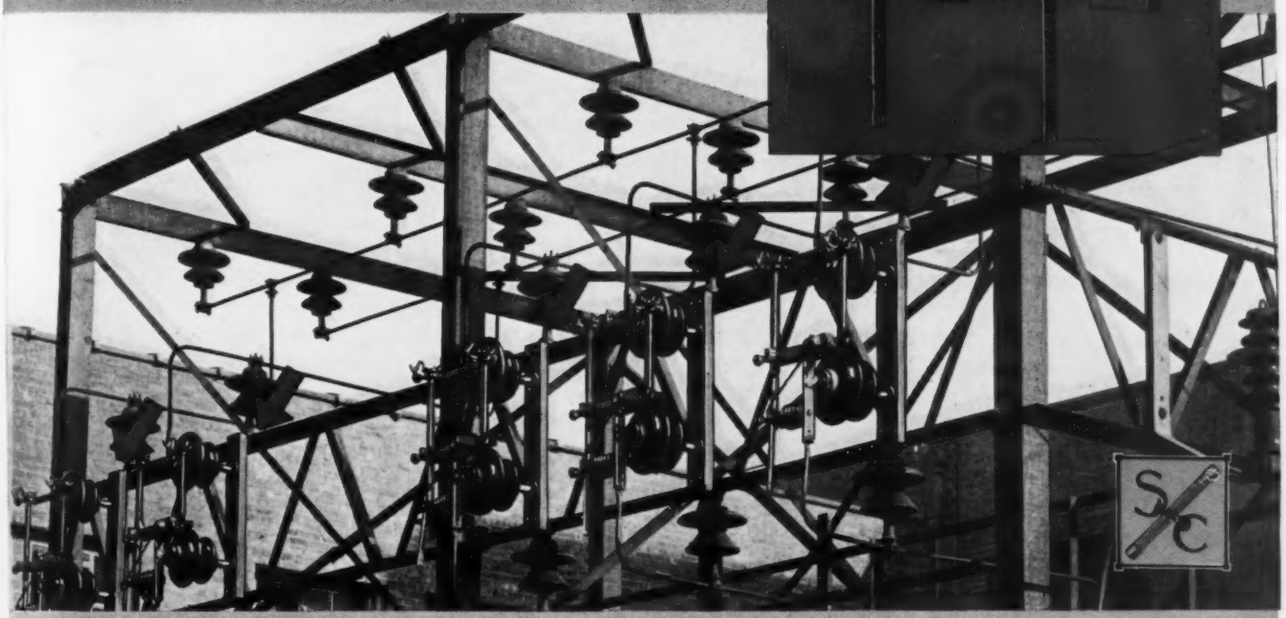
The oscillogram in Fig. 2(a), directly above, shows ground current, recorded on the fourth element, which has been stored and delayed for 8 cycles. The sixth element of the oscillogram Fig. 2(b) has 6 cycles delay.

The sudden displacement from its zero position shown on the fourth element of the lower oscillogram is a trip signal showing the point at which control current is applied to the opening coil of an oil circuit breaker. This indication is obtained from the secondary of a current transformer connected in the d.c. circuit supplying the station relay bell bus. It correlates each successive oscillogram with the accompanying circuit breaker operation and separates the time in cycles required for the relay to close contacts from the time required for the circuit breaker to part contacts and extinguish the arc.

FOR CUSTOMER SUBSTATIONS

Insure . . .
Maximum Protection
. . . and Continuity
of Service . . .
Restore Service Automatically





ELIMINATING interruptions—saving the load and the revenue—are of prime importance on large customer service.

The installation shows S & C Loadgard Reclosing Fuses on a 33KV Substation serving a large industrial customer.

If a fault occurs one fuse clears the circuit and through a reclosing action, automatically cuts the next fuse into the circuit. Time delay on reclosing can be furnished without additional cost.

S & C Liquid Type Reclosing Fuses are not affected by weather—they are self-enclosed and the operation is positive. They reduce servicing costs, are dependable years after installation—are comparable to an oil circuit-breaker in interrupting capacity.

You can apply S & C Reclosing Fuses to existing installations, too—at a small initial investment.

Let us make recommendations covering your reclosing fuse requirements.

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LOADGARD RECLOSING FUSES

Building Up THE LOAD

New ideas and practices in selling electrical equipment and service to commercial and domestic customers

Better Light for 30-Year-Old School

By LLOYD C. GARRISON
New York Power & Light Corporation

What the modern schoolroom is and is not wearing may be readily seen from the accompanying illustrations. Schools are casting off the harsh glare of direct light with its uneven and inadequate illumination and are dressing in a controlled brilliance, born of indirect lighting.

The before and after study was taken in one of the twelve classrooms in the 30-year-old school of district 8, town of Rotterdam, Schenectady County, N. Y. With the old lighting system two 150-watt lamps were suspended on drop cords in the center of the room. The bulbs were bare, except for a ribbed glass shade.

Today six of the rooms have four 500-watt, totally indirect fixtures for lighting. The other six rooms are in the process of being changed over. With the two lights farthest from the window on a separate switch, these may be lighted manually to help balance the illumination in the room during daylight hours.

Foot-candle readings, of course, indicate only the improved intensity of lighting, but the better quality of lighting produced through the elimination of the glaring light source was of even greater importance to the pupils and the teachers. Work at the blackboard is no longer done on the "dodge-and-write" method, for the usual deep shadows have been overcome. Naturally, the intensity of light has been vastly improved with the new system. The pupils in the last row from the windows have seen an increase in foot-candles from 5 to a present reading of 24. With a balanced intensity, there are no longer any preferred seats in the room, except, perhaps, the rear seats for those mischievously inclined.

Alvah Cameron, former chairman of the school board, under whom the lighting improvement was started, said:

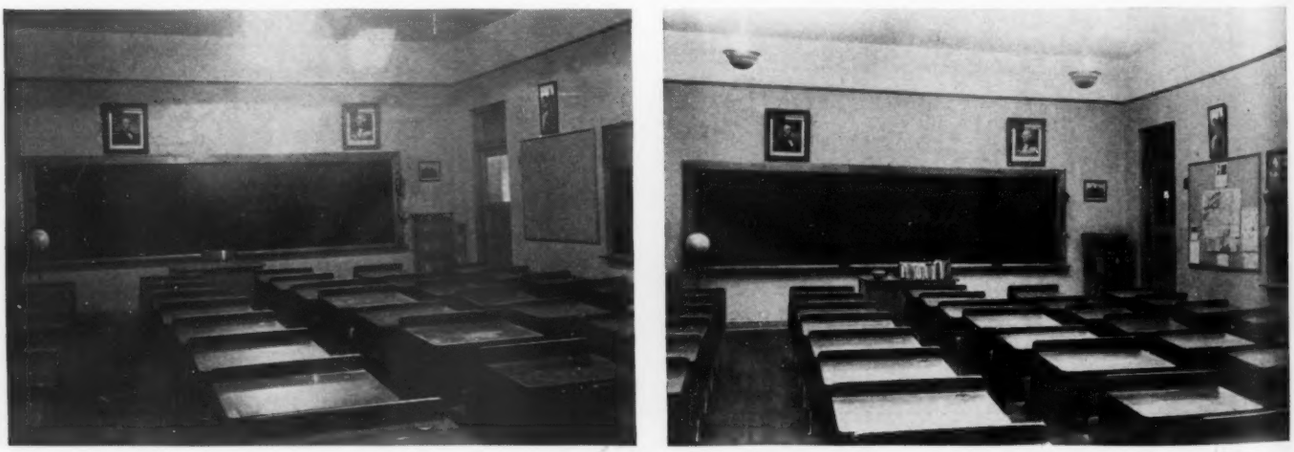
"Sometimes we're a little slow in getting started on new improvements, but when we do, we get the best. Since the parents have visited the school to see both the old and new lighting, they are all as enthusiastic about the lighting as I am."

Rewiring all rooms was necessary to accommodate the increased load, but every one in the district has seemed to agree that the money spent was a real investment in saving eyes and in improving the conditions for education.

•

Home Is Designed for Air Conditioning

Characterizing it as one of the first homes of its type, if not the first, to be designed and engineered for year 'round air conditioning, *McCall's Magazine* announced its March "Home of the Month"—No. 13 in the series started a year ago. In the first year of this activity some 65 model homes were built, exhibited—many of them



Old-style lighting (at left) was obtained from two 150-watt bulbs. At the right, four 500-watt totally indirect units provide 24 ft.-candles at desk surface

It's in the BOOKS

These books are but symbols of the rich records of results of our 30 years experimenting and experience — with Chromel, the first nickel-chromium heating-element alloy. They represent a library of facts that will never be completed. Thru them all, runs the continuous theme of: what was good enough yesterday, is not good enough today . . . . So, the Chromel we make today is a faithful servant of the appliance maker and his customer, and of the power company. Also, in the public's increasing acceptance for the electric range, the long life of those gleaming coils of Chromel wire plays a major part. Whatever your interest in electric heat, you may safely rely on the performance of Chromel heating-elements. If you're technically minded, you'll find interesting facts in Catalog-K which we will gladly send you on request. . . . . Hoskins Manufacturing Company, Detroit, Michigan.

HOSKINS CHROMEL

THE WIRE THAT MADE ELECTRIC HEAT POSSIBLE

HOME OF THE MONTH—Secret of the moderate cost of this six-room house is said to be the fact that it was designed and engineered for air conditioning summer and winter

completely furnished—and sold, after being visited by more than a half million homeseekers. Homes corresponding to the general plans drawn for the March home by the architect, J. Ivan Dise, are to be built for public inspection in these cities: Chicago, Des Moines, Omaha, Detroit, Grosse Point, Mich.; Glen Ridge and Westfield, N. J.; Canton and Dayton, Ohio; Portland, Ore., and Barrington, R. I.

Incidentally, a second article in the magazine suggests a method of completely furnishing the living room over a period of three years. It is worthy of note that the interior decorator recommends that the furnisher buy good sitting and *good lighting* the first year!

•

Farm Power Cuts Costs

By emphasizing the economies of electric service, the approach to wider use of farm power becomes more effective, according to comments before the New England Institute of Rural Electrification at Burlington, Vt., by F. L. Foss of the Western Massachusetts Electric Company, Greenfield. Comparatively few rural customers first receiving central station service have any definite plan of electrification worked out, and for this reason Mr. Foss believes that utility representatives should contact farmers in the field, especially where these are earning a living from the farm, and ascertain the entire situation as to the money which they can invest in wiring of buildings and in electrical equipment, and then with their assistance and suggestions proceed to lay out a plan for complete electrification, over a longer or shorter period.

If finances do not permit complete wiring at the start, it is of first importance to see that the service entrance is large enough for the ultimate installation. Many thousands of dollars are yearly spent in replacing service entrances, due to lack of foresight. In many cases the proper capacity could have been installed at $15 or $20 additional cost, against from $75 to $100 for replacing the old service.

Turning to service economies on the farm, Mr. Foss emphasized that a pressure water supply will begin to pay dividends from the start. On the dairy farm it speeds up the cleaning of milking equipment, contributes toward healthier stock and increases the output of poultry. Radio sets furnish the latest current prices of farm products, and electric milking enables the size of the herd to be increased without the extra cost of hand milking. Electric cooling is almost a necessity in meeting sanitary regulations (cooling to 50 degrees within two hours of milking) and in holding milk at proper temperatures prior to shipment. An average cooler will use about 1.2 kw.-hr. per 100 lb. of milk cooled. Thus, a farmer collecting 15,000 lb. of milk per month would use about 180 kw.-hr. for this work, costing him $5.40 at 3 cents per kw.-hr. This is equivalent to cooling with ice at 12 cents per hundred. A western Massachusetts farmer saved one hour a day for other work in addition to a cash economy, after installing electric milk cooling. With these equipments plus electric sterilization the dairy farmer should be able to command a top price in the market, producing milk at a lower handling cost than in any other way.

On poultry farms adequate wiring insures proper voltage drops and more reliable service; electric brooders save labor, eliminate the fire hazard, do away with loss of needless heat, produce more uniform flock growth, earlier feathering, healthier and heavier chicks. In general, the cost of operation does not exceed that of coal- or oil-burning brooders. Electric water warmers (producing temperatures around 40 to 50 deg.) increase egg production. "If utility rural representatives will go out and talk with the farmer with the intention of increasing his income and reducing his labor cost, so that he can get along with less hired help, I believe they will go a long way toward the making of a satisfied customer and one who will eventually be a valuable asset to the company," Mr. Foss stated.

Kitchen Revenue

One electric kitchen equals eight new average customers in energy consumption, says the General Electric Company, in answer to its own question, Is it worth while to promote the electric kitchen idea? To back up this statement the figures below are offered.

	Watt Demand	Annual Kw.-Hr. Consumption	Rate, Cents	Annual Revenue	Annual Revenue per Kw. of Demand
Refrigerator	200	400	4.0	$16.00	$80.00
Range	2,500	1,500	2.0	30.00	12.00
Water heater	3,000	3,000	1.0	30.00	10.00
Dishwasher	250	50	4.0	2.00	8.00
Lighting	400	360	4.5	16.20	40.50
Small appliances	100	50	4.5	2.25	22.50

The MOTOR that Made HISTORY~

LOWER STARTING CURRENT THAN ANY OTHER TYPE MOTOR

For more than 33 years Century Single-Phase, Brush-Lifting Motors have made history—eliminating the extra cost of over-motoring, because they have a lower starting current and a higher starting torque than any other type motor.

Long before Air Conditioning was even thought of as an industry, they established many outstanding performance records, driving Refrigerating Machines, Compressors, Pumps and all similar Air Conditioning equipment—in all kinds of service, in all climates, in all parts of the world.

They were more than adequate and ready for Freon Compressors long before Freon Gas was ready for refrigeration.

Find out about the low starting current and high starting torque advantages of Century Single Phase Brush Lifting Motors—they carry the load, economically!

●

CENTURY ELECTRIC COMPANY

1806 Pine Street St. Louis, Mo.

Offices and Stock Points in Principal Cities

REPULSION START INDUCTION BRUSH LIFTING

Century MOTORS

News ABOUT PEOPLE

Boston Edison Names District Managers

C. Louis Gagnebin, Jr., of the underground service division of the sales department, has been appointed district manager for the Boston Edison Company in Brookline, Brighton and Allston. Educated at Harvard College, he joined the company in 1924. Herbert J. Connors, since 1925 connected with the station engineering department and formerly engaged in plant engineering work for Stone & Webster, Inc., has been made manager in the Roslindale, Hyde Park and West Roxbury areas, with headquarters at West Roxbury. Joseph E. Pellegrini, for many years construction engineer in underground service and an employee since 1912, has been appointed district manager for East Boston, and the "north" and "west ends" of Boston for the Edison company.

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► R. L. SMITH, formerly an electrical engineer for the Buffalo, Niagara & Eastern Power Corporation, Buffalo, N. Y., now is employed by the Stone & Webster Engineering Company, Boston, Mass.

► F. M. FARMER, vice-president and chief engineer Electrical Testing Laboratories, New York, N. Y., has been appointed a member of the executive committee of the American Institute of Electrical Engineers to fill the unexpired term of the late Junior Past-President E. B. Meyer.

► HUGH A. WARNER, for the past two years manager of the Mississippi division of the TVA with headquarters in Tupelo, has been appointed director of electrical development for the Authority with headquarters in Chattanooga, Tenn. He will be succeeded at Tupelo by Earle R. Wall of Jackson, Tenn. A graduate of the Georgia Institute of Technology, Mr. Warner has had extensive experience with manufacturing and power companies in Georgia, North and South Carolina, Florida, Alabama, Mississippi, Louisiana and Tennessee.

UNITE AGAINST POOR WIRING—Notable figures in the electrical industry at Boston joined forces recently in support of high-grade construction work, climaxing a two-day meeting of the Massachusetts State Association of Master Electricians. V. C. Bruce Wetmore, (left front) dean of Boston wholesalers, announced his willingness to lead a movement for legislation against "basket" standards and "fly-by-night" contracting; Thomas H. Carens, Boston Edison (right front), represented the utility interest in developing contracting on a better basis, and C. A. Stone, New England *Electrical News*, (rear left) and B. L. Whittemore, president-elect of the association, added their support to the movement.

A. W. Kraft New President of New Haven Utility

Albert W. Kraft, formerly secretary-treasurer of the United Illuminating Company, New Haven, Conn., has been elected president at a recent meeting of directors. Mr. Kraft succeeds JAMES ENGLISH, founder of the company and its president for more than 50 years. Mr. English will continue as chairman of the board, a newly created office. Mr. English founded the old New Haven Electric Light Company in the '80s. Subsequently the company was consolidated with the Bridgeport Electric Light Company and named the United Illuminating Company. The directors also elected ALFRED W. CHASE to succeed Mr. Kraft as secretary and treasurer.

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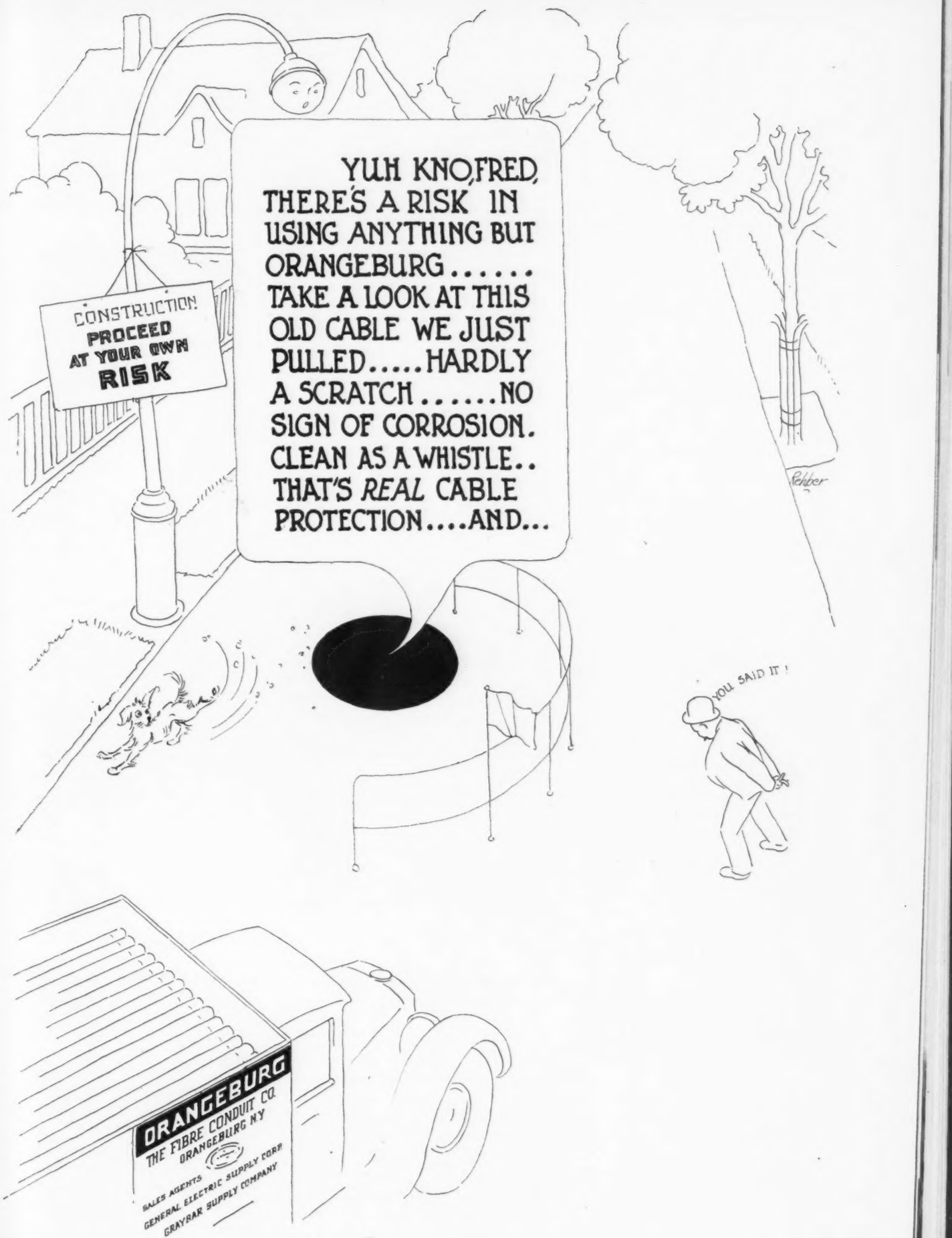
► LEONARD W. CRUMP, formerly lighting engineer in the Norfolk division of the Virginia Electric & Power Company, has recently been appointed industrial engineer for the Oklahoma Natural Gas Company.

► J. LEROY SPEIGHTS, chief electrical inspector for the Virginia Electric & Power Company, has been chosen president of the Electric League of Richmond. Mr. Speights has been identified with Virginia Electric & Power since 1924. He is a national figure in the electrical inspection field, being vice-president of the Southern section of the International Association of Electrical Inspectors.

► WHITFORD DRAKE, executive-vice-president of Electrical Research Products, Inc., has been elected president to succeed Edgar S. Bloom. Mr. Bloom is president of Western Electric Company. Mr. Drake became associated with Western Electric in 1924 and has been connected with Electrical Research Products since its


CONSTRUCTION
PROCEED
AT YOUR OWN
RISK
YUH KNO, FRED, THERE'S A RISK IN USING ANYTHING BUT ORANGEBURG..... TAKE A LOOK AT THIS OLD CABLE WE JUST PULLED.....HARDLY A SCRATCH.....NO SIGN OF CORROSION. CLEAN AS A WHISTLE.. THAT'S *REAL* CABLE PROTECTION....AND...
Pekber
YOU SAID IT !
ORANGEBURG
THE FIBRE CONDUIT CO.
ORANGEBURG N.Y
SALES AGENTS
GENERAL ELECTRIC SUPPLY CORP
GRAYBAR SUPPLY COMPANY

formation in 1927. He was made executive vice-president a year ago. Daniel C. Collins has been elected a vice-president of Electrical Research Products and T. Brooke Price a director.

▶ J. S. BROWN, who has been employed in the survey department of the Potomac Electric Power Company, Washington, D. C., is now employed in the electrical engineering department of the Duquesne Light Company, Pittsburgh, Pa.

▶ I. D. APPLEGATE, electrical engineer, has joined the staff of the Ideal Commutator Dresser Company, Sycamore, Ill. Mr. Applegate will be in charge of engineering, design and development of automatic voltage, current and speed regulators. He was formerly connected with the Westinghouse Electric & Manufacturing Company at East Pittsburgh.

▶ THOMAS M. SINCLAIR has been appointed to the position of purchasing agent of the Line Material Company with headquarters at the company's main. office, South Milwaukee, Wis. Having been engaged in industrial purchasing for many years, Mr. Sinclair brings a wealth of experience to his new position. He succeeds the late George E. Smith, who directed Line Material Company purchasing for 25 years.

F. L. HUNT, who recently assumed the duties of vice-president of Western Massachusetts Companies and of each of its constituent utility companies. He has been assigned the duty of directing the operations of these companies. Mr. Hunt is a fellow of the A.I.E.E. and has participated actively in the committee work of that society.

▶ THOMAS H. SPAIN has been appointed to the newly created position of advertising manager of the Public Service Corporation of New Jersey. Mr. Spain has been associated with Public Service since 1927. He was formerly connected with the publicity department of the Ingersoll-Rand Company in New York. He is a director of the Public Utilities Advertising Association.

▶ C. W. THELEEN has been appointed sales manager for the Lincoln district of the Iowa-Nebraska Light & Power Company. Mr. Theleen has served the company in various capacities for nine years.

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OBITUARY

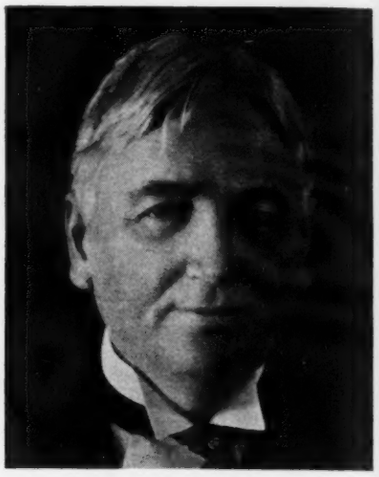
Arthur Williams

Arthur Williams, whose death was announced in ELECTRICAL WORLD, April 17, page 7, had been a national figure in the activities of the electrical industry for many years. Born in Norfolk, Va., 68 years ago, Mr. Williams rose by his own efforts to become one of the executives of a great utility company. When he retired in 1928 as vice-president of the New York Edison Company in charge of commercial relations, he terminated an association that had covered a period of almost 45 years.

Entering the service of the Edison Electric Illuminating Company in New York in 1885, he was intimately connected with the very beginnings of the electric lighting industry in America, which centered in the old Pearl Street station. After serving in various operating capacities, Mr. Williams was made general commercial manager in 1915 and in 1924 became a director of the New York Edison Company and vice-president in charge of commercial relations.

Public relations and business diplomacy were his forte, and in safety and welfare work he always took a keen interest, having been decorated by both the French and Spanish governments for his accomplishments in this field. His contributions to the progress of the various branches of the electrical industry won frequent recognition. In the course of his career he was president of the National Electric Light Association, the Association of Edison Electric Illuminating Companies, and the New York Electrical League. He was a member of the Edison Pioneers and a fellow and life member of the American Institute of Electrical Engineers.

Although he relinquished most of his business connections when he retired from the New York Edison Company, Mr. Williams remained for some years as a director of the Metropolitan Life Insurance Company and at the time of his death was president of the Forty-second Street Property Owners and Merchants Association, Inc. He continued to maintain the many social, cultural and recreational contacts he had established.



Arthur Williams

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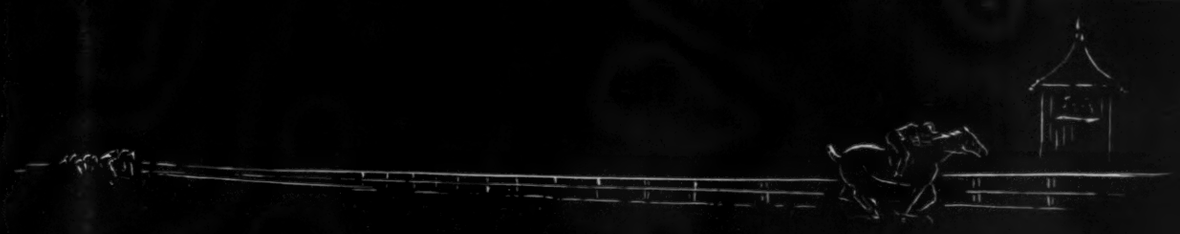
▶ ROBERT D. GOULD, treasurer of the Portable Electric Tool Corporation, Fitchburg, Mass., died at a hospital in that city on April 13, after an illness of several weeks. He was born in Roxbury, Mass., 77 years ago, and was also treasurer of the Fitchburg Grinding Machine Corporation.

▶ H. A. COUVES, general manager and director of the North Eastern Electric Supply Company, England, died recently in London. Mr. Couves was appointed engineer of the power department of the Newcastle Electric Supply Company (now the North Eastern) in 1906, became general manager in 1926 and was made a director in 1934. He was chairman of the North-East England District Consultative Technical Committee of the Central Electricity Board and was associated with many other electrical bodies.



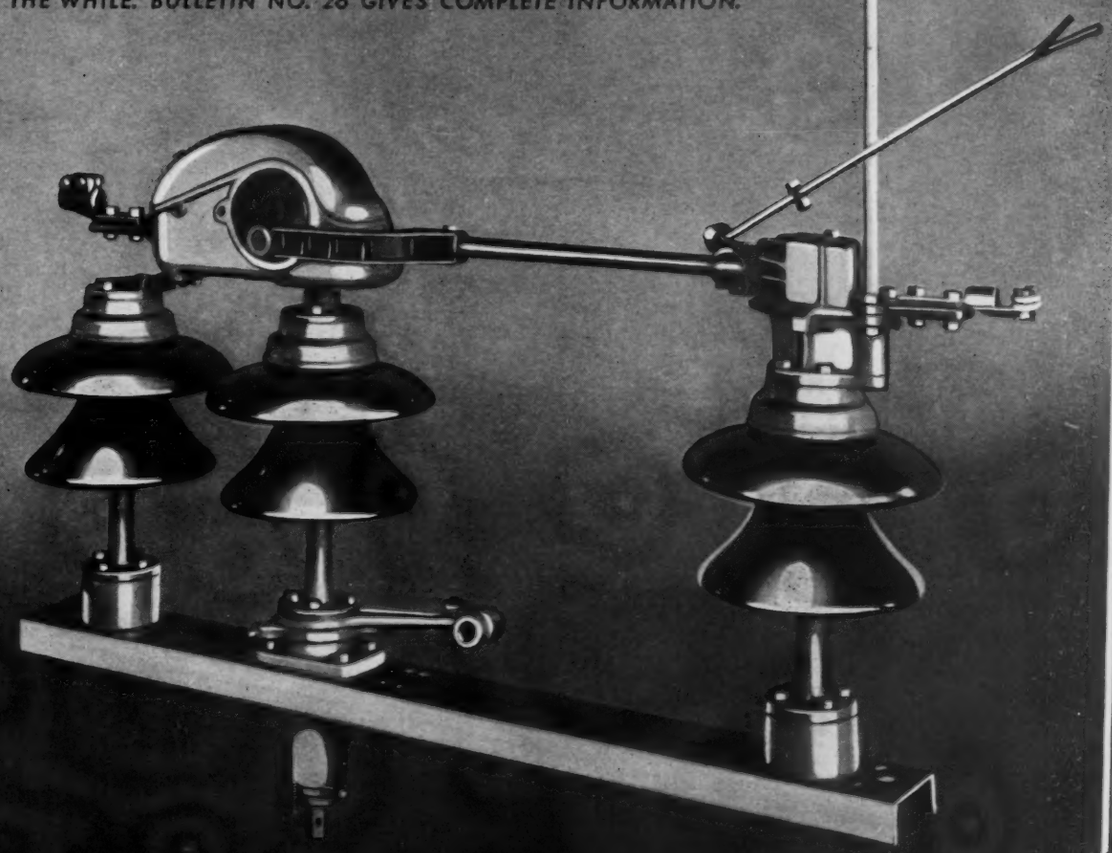
"WAY OUT IN FRONT"

Five years ago there were **three** good makes of air-break switches traveling along neck-and-neck . . . well ahead of all others . . . and HI-VOLTAGE was one of them.

Since then we have assured dependable operation under all weather conditions by adding the following exclusive features.

1. **Totally enclosed bronze operating mechanism.**
2. **Monel ball bearings.**
3. **Graphite insert bearings.**

NOW HI-VOLTAGE *IS WAY OUT IN FRONT . . . GAINING ALL THE WHILE. BULLETIN NO. 26 GIVES COMPLETE INFORMATION.*



- TYPE S-W VOLTAGE TO 34.5 KW
- WRITE FOR BULLETIN NO. 26

HI-VOLTAGE EQUIPMENT CO.

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Manufacturing AND MARKETS

Westinghouse Orders Set Quarter Record

Orders booked by Westinghouse Electric & Manufacturing Company for the first quarter this year totaled $74,242,584, as against $42,515,469 a year ago. Sales billed totaled $46,673,300, against $33,981,280. It was stated that orders booked for the three months were the highest for any quarter of record. Unfilled orders on March 31 were $73,735,326, the highest since 1923.

For the year ended March 31 orders booked totaled $214,248,419, against $135,381,901 in the preceding year. Sales billed totaled $167,161,051, against $130,357,033.

Net income for the quarter ended March 31 was $5,341,512, equivalent to $2 a share, as against $3,732,454, or $1.40 a year ago. For the year ended March 31 net income was $16,708,349, or $6.27 a share, as against $13,389,338, or $5.02 a share in the preceding year.

The payroll for the first quarter totaled $21,836,000, against $15,031,000 a year ago. The average number of employees was 49,100, against 37,700.

George H. Bucher, executive vice-president, was made a director.

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Air-Conditioning Units to Be Installed by York

An order from Warner Brothers for the air conditioning of nine theaters has been received by the York Ice Machinery Corporation, according to S. E. Lauer, vice-president and general sales manager. The theaters are located in Chicago, Ill.; Wilmington, Del.; and York, Pa.

York sales for the first four months of the fiscal year totalled $6,145,250, an increase of 93 per cent over the same period in the preceding fiscal year. January sales were the largest for any single month in the history of the company, Mr. Lauer stated. A large percentage of the business resulted from modernization programs.

•

Manufacturers Issue Quarterly Earnings

Among the electrical manufacturing companies that have issued earnings statements are the following:

Weston Electrical Instrument Corporation—Profits for the first two months of 1937 were $51,718, compared to $30,158 earned in the 1936 period. At the annual meeting Edward F. Weston, president, announced that March profits would be even better in comparison with last year. Incoming orders for March were 48 per cent over last year and outgoing freight shipments for the first quarter were 26 per cent ahead of the 1936 period. Directors declared a dividend of 25 cents a share on the common stock, payable on May 14.

Superheater Company—Excluding Canadian affiliate, March quarter, net income, $830,109, compared with net income in first quarter last year of $215,694. Combustion Engineering Company, a subsidiary of the Superheater Company, operated "in the black" for the first two months of 1937, George L. Bourne, chairman, stated at the annual meeting.

•

Air Unit Orders

The value of orders booked for air conditioning systems and equipment in February was well above the value in February last year, according to reports by the Department of Commerce. These orders were valued at $4,830,746, compared with $2,680,212 in the corresponding month of last year. The February orders, however, showed little change from the preceding month, when orders were valued at $4,876,322. For the two-month period January and February orders this year showed a substantial improvement over the similar period of 1936, being valued this year at $9,707,068, compared with $5,038,459 in the 1936 two-month period.

Record Orders Shown by General Electric

General Electric Company received orders totaling $105,747,030 during the first quarter this year, according to Gerard Swope, president. This compares with $59,569,879 in the same period last year, an increase of 78 per cent. Mr. Swope stated that this was the largest first quarter in the history of the company.

During 1936 approximately 22,000 employees submitted suggestions to the company and $51,357 was paid for new ideas adopted. This compares with 16,000 submitting suggestions in the preceding year and cash awards of $35,360.

Sales billed for the first quarter totaled $73,412,420, as against $51,423,071 a year ago. Profit was $11,626,408, equivalent to 40 cents a share, against $7,086,830, or 25 cents a share in the first quarter last year.

•

Blaw-Knox Buys Power Piping

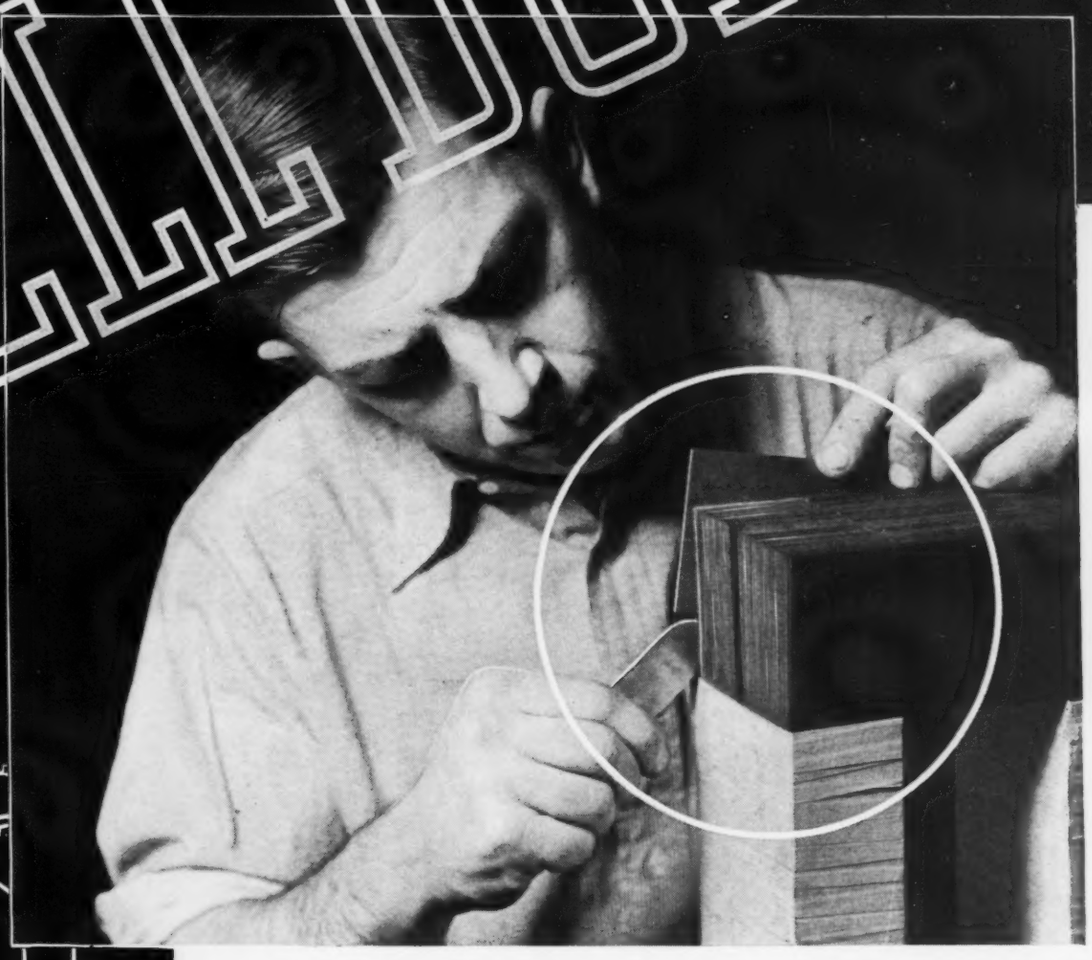
Blaw-Knox Company has acquired the property and business of the Power Piping Company of Pittsburgh, W. P. Witherow, president of Blaw-Knox, has announced. Power Piping Company has been engaged in the design, manufacture and erection of piping for power plants, oil refineries, water works and industrial plant usages for all pressures and purposes. The business will be operated under the name of "Power Piping Corporation." William V. Quartz will continue in charge.

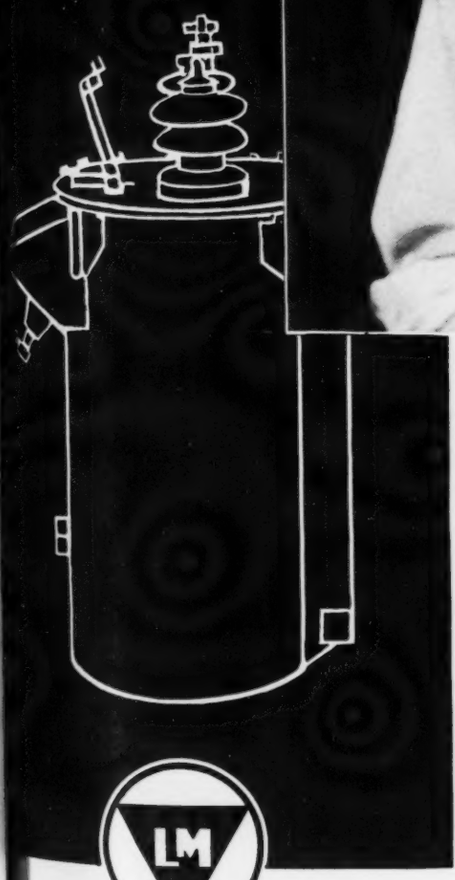
•

Tagliabue Closes Plant

More than 300 employees of C. J. Tagliabue Manufacturing Company, manufacturer of thermometers and instruments, members of the United Electrical & Radio Workers of America, a CIO group, have struck at the

★ A LITTLE THING WELL DONE





insuring outstanding efficiency in

L-M DISTRIBUTION TRANSFORMERS

Stacking cores for L-M Transformers is a precision job. With extra care, the assembler taps every lamination precisely into its proper place. Air gaps are reduced to minimum. The result is a near-perfect magnetic circuit . . . with reduced magnetic reluctance, low exciting current, low core loss, and high mechanical strength. This is but one of the "little things well done" to assure outstanding service from L-M Transformers. Write to So. Milwaukee, Wis., for L-M Transformer Bulletin, LMB 6364.

LM

LINE MATERIAL CO.

company's Brooklyn plant, according to the union. C. D. Waters, president of the company and president of the Brooklyn Chamber of Commerce, however, revealed the company closed its plant when it found that it "could not arrive at any reasonable agreement" with the union, "to protect the property."

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Manufacturers Make Sales Assignments

Electrical manufacturing companies have recently made the following sales assignments:

Ten range supervisors of the Nash-Kelvinator Corporation were recently appointed, including Harry J. Moeller, Western region, with offices at Seattle; R. H. Jancke, Denver; H. S. Stratton, Nutley, N. J.; Carl J. Theobald, Detroit; Fred A. Ramsdell, Glenn Ellyn, Ill.; E. C. Sherman, Sunnyside, Long Island, N. Y.; W. A. Wilson, Kansas City, Mo.; T. L. Craig, Birmingham, Ala.; George Eastman, Raleigh, N. C., and C. N. Smith, San Francisco.

Arvid Wickstrom has been named distributor for The Standard Transformer Company of Warren, Ohio, for the northern peninsula of Michigan, northern part of Wisconsin, the Dakotas and Iowa. His head quarters will be in Minneapolis.

•

Second Mansfield Pay Rise

The second pay increase within three weeks for nearly 4,000 employees of the Westinghouse Electric & Manufacturing Company has been announced at the Mansfield, Ohio, plant. The new wage schedule will increase the annual payroll for the Mansfield plant by $500,000, bringing the total annual figure to $6,500,000. Under the revised rates men employees will receive an increase of 6 cents per hour and women employees 5 cents, according to Vice-President Allen.

Wage increases for 5,700 hourly workers in the Chicopee Falls and East Springfield Mass., plants have been announced, effective April 19. L. A. Osborne, manager, did not state the specific percentage of increase, but estimated the annual total at $890,000. The pay of salaried workers is being reviewed, he said.

New York Metal Prices

	April 14, 1937 Cents per Pound	April 20, 1937 Cents per Pound
Copper electrolytic..	15.50*	15.50*
Lead Am. S. & R. price.....	6.00	6.00
Antimony.....	16.125	15.875
Nickel ingot.....	35.00	35.00
Zinc spot.....	7.35	7.35
Tin Straits.....	61.00	57.375
Aluminum, 99 per cent.....	20–21	20–21

* Delivered Connecticut Valley.

Field Reports on Business

A slowing down in business activity is being evidenced as indicated by field reports to ELECTRICAL WORLD. *Strikes fostered by the C.I.O. continue to cloud the labor situation and cause unrest. Caution is being felt in some quarters, causing a slowing down in forward orders. A large back-log of utility buying awaits lifting of government pressure.*

NEW YORK

Uncertainty concerning the course the Administration will pursue in coming months is being reflected in a slowing down in industrial activity. The fact that another large Federal deficit looms and tightening of the government's purse strings seems out of the question has created a situation where business is pausing and refraining from placing future orders of any great size. Activity now is mostly of a necessity basis with the future being left to take care of itself.

General Electric has received an order for a 110,000 kw. turbine generator for Ford's Rouge plant. Orders have been placed for six turbines to be installed in steam plants of subsidiaries of Commonwealth & Southern in Indiana, Illinois, Ohio, Michigan and Pennsylvania.

Metal prices are now well down from the tops of the year. Domestic copper sales over the past week-end totaled 3,296,000 pounds, against 794,000 the previous week-end. So far this month sales have totaled approximately 26,512,000 pounds. Orders for wire and line equipment are tending upward.

Manufacturers report orders billed as well as shipments at figures the highest in years. Increasing expenditures for heavy equipment by utilities and continued high sales of appliances indicate good future business for manufacturers.

PACIFIC COAST

Despite scattered cannery strikes and union organization of department stores, business continues excellent in all branches, being accelerated, perhaps, by the prospect of price and labor advances. Residential building is averaging a third over last year with a 50 per cent general coast increase in building volume.

Range sales are good especially in Bay and Salt Lake areas and are expected to be considerably increased in northern and central California area by the Pacific Gas & Electric Company's May campaign, characterized as the first general effort by all branches of the industry.

New power construction includes 3 transformers, 1000 kva. each, and a 6½ mile line to handle increased mining load in American River district, pole line reconstruction in Woodland area, 1000 forty and sixty foot poles, $8,000 cable and $10,000 circuit breaker for Los Angeles and a $500,000 bond issue to supplement a $300.000 PWA grant for the Fall Brook irrigation district. The natural resources commission has recommended that approximately $50,000,000, a huge sum even for these days, be expended in developing the drainage basin of northern and central California. Recent machinery orders include a $10,000 regulator for Modesto irrigation, $40,000 of metal clad switch equipment for the Bay area, a $10,000 regulator for the Fresno area, 1667 kva. transformers, value $7,000, for Reno, and a 2-circuit switch house, value $5,000 for the Palo Alto municipal plant. Copper prosperity is reflected in the purchase of 4 electric trolley locomotives, value $250,000, for the Utah Copper and projected Phelps-Dodge smelting and coating plant extensions of approximately $1,000,000 for Douglas, Ariz.

NEW ENGLAND

Electrical equipment buying in this district maintained a steady trend during the past week. Interest in heavy power generating machinery is occupying the attention of designing engineers, who have under consideration plans involving installations of turbo-generators which will develop over 100,000 kw.

Motor sales are brisk; one manufacturer reports increasing demands for special-purpose motors; fractional-horsepower motors orders, according to one well-known manufacturer, are piling up, with long-time deliveries complicating the production of some appliance manufacturers. Small switch and control apparatus sales are forging ahead; central stations are buying in good volume.

Street lighting is moving ahead; one prominent illuminating engineer reports a strong trend toward the use of mercury-vapor lamps among the municipalities in this area. Electric furnace sales for the first quarter recorded by one nationally known manufacturer will reach more than 30 per cent over the volume for the corresponding quarter last year.

Contractors' supplies are moving with a strong trend. A manufacturer of wire and cable reports orders far in advance over last year. Wiring devices and galvanized conduit are selling well. Merchandising is progressing favorably. Refrigerator sales are showing marked strength; recently 160 electric refrigerators were placed for new apartments and one prominent distributor is contracting about one carload a week in eastern Massachusetts. Range sales are gaining.

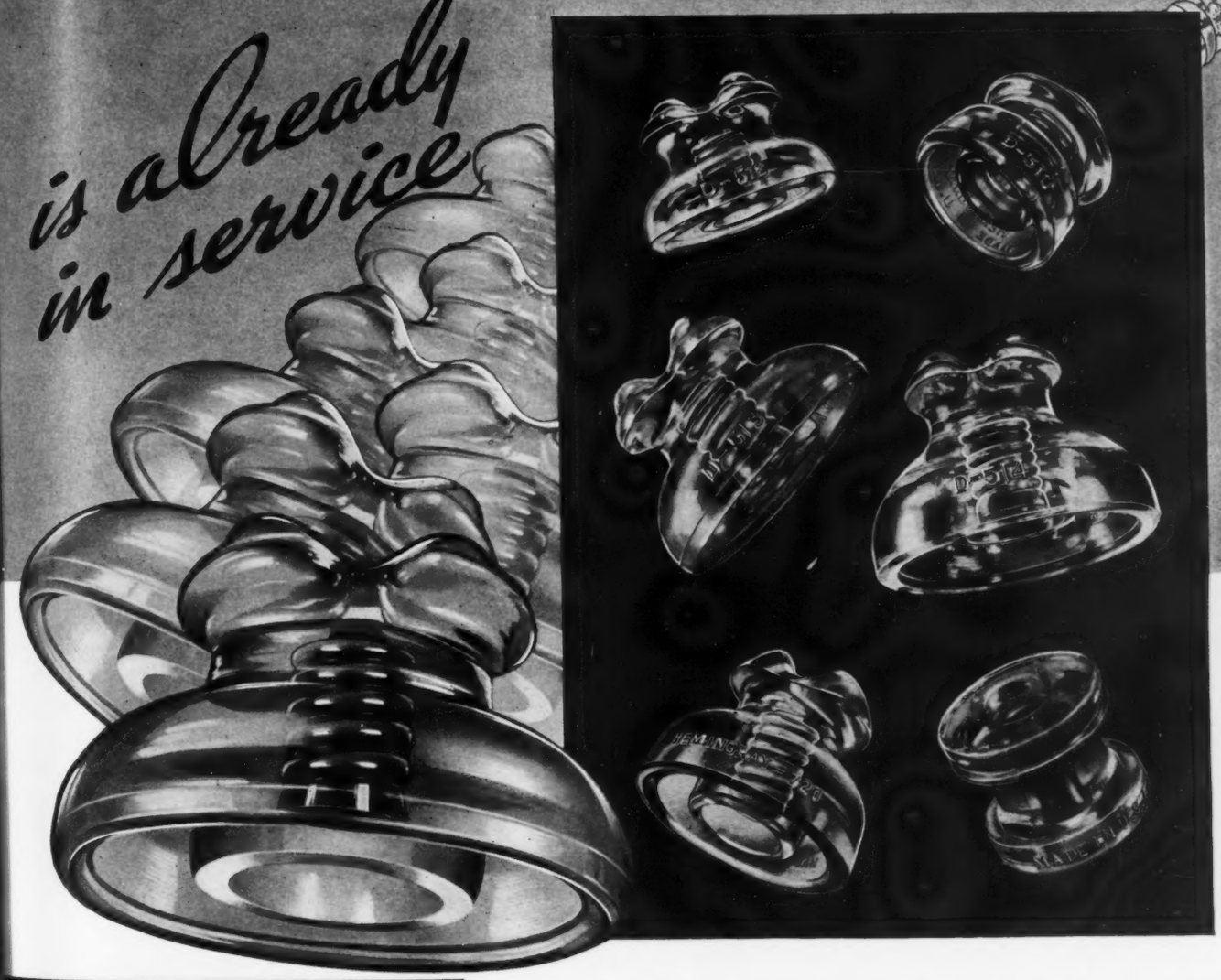
CHICAGO

General business in this area last week showed mixed trends, indicating that a moderate curtailment of activity may be at hand. The demand for steel has lightened preceptibly although automobile production is expanding as rapidly as possible. The electrical energy output for the Chicago area gained approximately two per cent over the previous week. The building industry which should be contributing a glow to the picture is laboring under the burden of high material and labor costs with the result that the spring acceleration is smaller than was anticipated.

In general, orders for electrical equipment are being received in good volume. Some cancellations have been reported by manufacturers of smaller apparatus. A number of contractors report fair-sized inventories of conduit and wiring devices. Central station purchases are heavier and construction activity is progressing, one contract for $50,000 having been awarded last week. Plant expansion and rehabilitation are still going forward in the Stock Yards and steel mill district, resulting in substantial orders for electrical equipment.

THE ONE-BILLIONTH HEMINGRAY INSULATOR..

is already in service



- Brass-bushed for greater strength, perfect threads and full protection against pin expansion.
- Hemingray provides many advantages: greater mechanical strength . . . sustained dielectric strength . . . unaffected by sudden temperature changes . . . withstands maximum insulator pin expansion . . . never ages or deteriorates . . . controlled uniformity of product . . . all surfaces impervious to moisture . . . tougher — withstands rough handling . . . clear, flawless for easy inspection.

◆ **These modern HEMINGRAY GLASS INSULATORS are the result of a long-specialized experience backed by extensive research and exhaustive testing.**

HEMINGRAYS are the practical common-sense insulators to buy for distribution and rural line service. They are efficient — never age — and cost less to buy and to own.

Their performance in service backs up the judgment of the man who buys them.

If you aren't using the new HEMINGRAYS on your distribution lines, order some today from your jobber and note the difference — or write for samples and prices.

Owens-Illinois Glass Company, Hemingray Division, Muncie, Indiana.

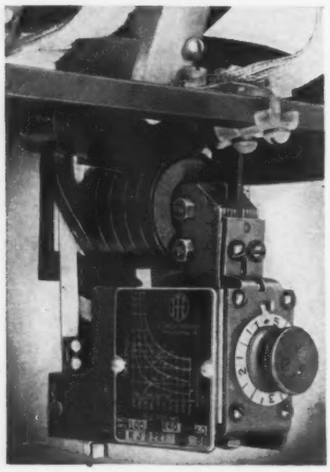
FOR MODERN POWER LINE INSULATION

Order HEMINGRAY Glass INSULATORS

New EQUIPMENT AVAILABLE

Thermal Overload Device

Combining direct-acting magnetic trip with thermal time delay, this device, intended for use on the company's a.c. motor protecting circuit breakers, is said to dis-



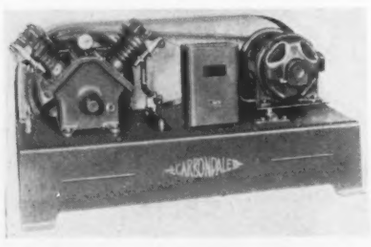
Thermo-magnetic overload feature; standard types for any a.c. motor up to 1,000 hp., 550 volts. **I-T-E Circuit Breaker Co.**, Philadelphia.

criminate between normal and unsafe overloads. It is so adjustable to load and other operating conditions, including ambient temperatures, says the manufacturer, that the circuit is opened only when the intensity or the time element is such as to exceed a safe limit. Device has a different current-time tripping characteristic for each number on the index knob; these curves are reproduced on the side of the feature.

•

Refrigerating Units

New self-contained low-pressure refrigerating units are designed to use either freon 12 or methyl chloride as a refrigerant and are recommended by the makers for both air-conditioning service and general refrigerating purposes. V-type compressors, from four to eight cylinders, form a compact compressor unit. Safe operation is assured, it is claimed, by interlocking the motor starter and the high-pressure cut-out. Starting is accomplished by means of pressure or temperature changes and uses the usual automatic starting features. Receiver is integral with shell-type condenser.

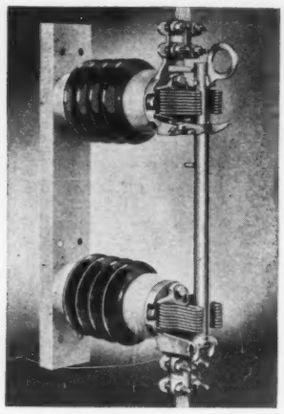


Condensing unit. **Carbondale Division, Worthington Pump & Machinery Corp.**, Harrison, N. J.

•

Disconnect Switch

A hook-operated disconnect switch featuring multi-point contacts and station post insulators is a recent development. Each of the fingers making up the contacts is individually sprung from the base, thus assuring their alignment along the tubular blade. This arrangement is said to afford full conductivity together with positive alignment;



Ratings, 7,500/12,500 Y to 34,500 volts; 200 to 400 and 600 amps. **James R. Kearney Corp.**, St. Louis.

point pressure fingers are also cleaned by friction each time switch is operated. Switch is also available with truss type blade and prying type blade latch.

•

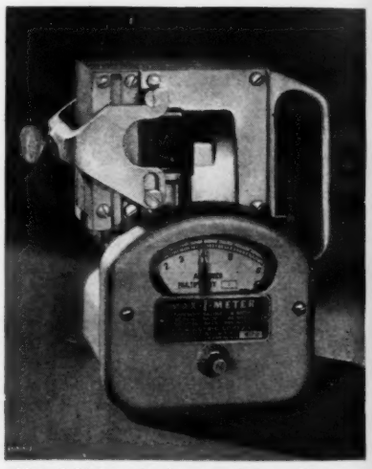
Explosion-Proof Starters

Explosion-proof motor starter. **Westinghouse Electric & Manufacturing Co.**, East Pittsburgh.

New explosion-proof, manual motor starters are said to be particularly adapted for control and protection of single-phase and polyphase squirrel-cage motors. Overload protection is provided by the disk thermostat; the starters have quick-make and quick-break toggle-type mechanism, trip-free handle, are front operating, have long-life contacts and corrosion-resisting finish on metal parts. Starters can be changed from one rating to another by changing heaters, a process which may be carried out without disturbing the trip mechanism, it is said.

Demand Meter

When clamped on a conductor and left in position for 30 minutes or longer, this apparatus measures and records the maximum current flowing through the conductor.



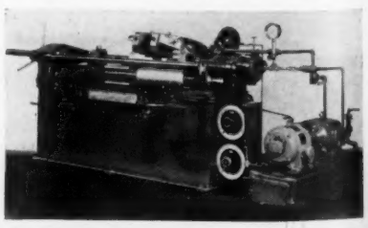
Max-I-Meter; in four models, with two and four ratios, full scale reading, 6 amp.; Max-I-Tran; 5 amp. secondary, four ratios: 8/1, 20/1, 40/1, 100/1. **H D Electric Co., Chicago.**

Device combines an electrothermal type (Lincoln) maximum demand meter with a multi-range split core current transformer. The transformer is also available as a separate unit (Max-I-Tran) to be used with an a.c. ammeter of the indicating or graphic type. Both units are compact and weatherproof, says the manufacturer, and are designed especially for outdoor use.

•

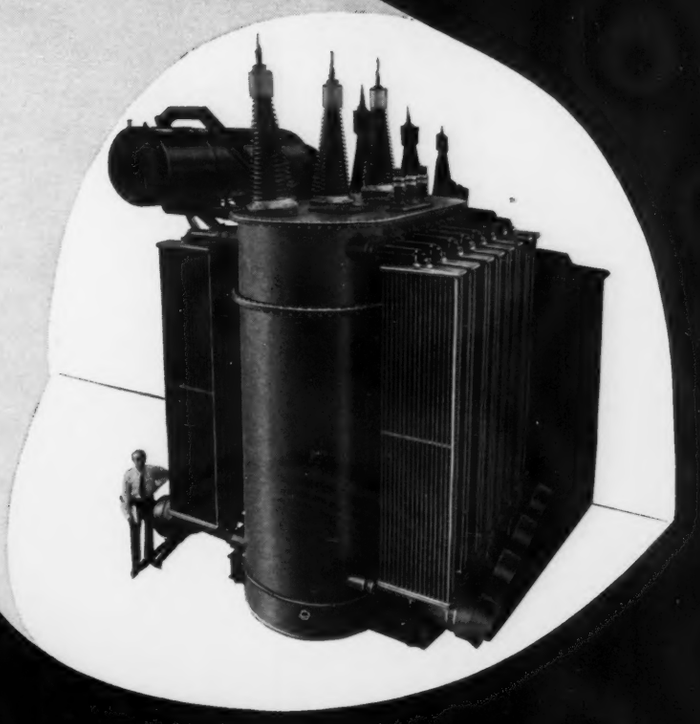
Flash Welder

A precision flash welder has been designed to insure accuracy in its work and to prevent deflection to any degree that might interfere with the accuracy required in the welding of drills, reamers and tools of that sort, according to the manufacturer. Back-up stops are mounted directly on top of the frame instead of overhanging one



Model F 29; 300-kva. transformer standardly wound for 220, 440 or 550 volts, 60 cycles. **Thomson-Gibb Electric Welding Co.**, Lynn, Mass.

n the Spotlight-



with its PERFORMANCE!

PERFORMANCE is the yardstick by which transformer quality is measured. Repeat orders show what satisfied users think of Moloney performance. Past performance is indicative of future performance where Moloney is concerned. The same policy which, in the past, has earned Moloney's enviable record, is still being rigidly maintained. It is this policy of liberal design, finest materials and unexcelled workmanship that assures Moloney performance.

Specify **MOLONEY . . .** *Get* **PERFORMANCE!**

MOLONEY **POWER** TRANSFORMERS

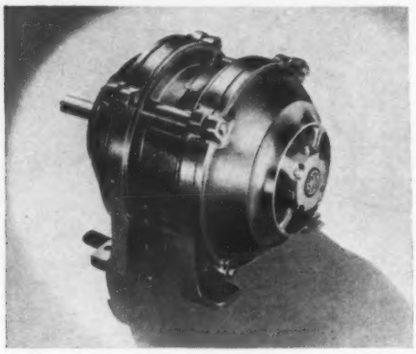
ST. LOUIS

end, and both work stops and tie rods strengthening the frame are on a common center line with the center of welding pressure. Transformer taps provide eight points of voltage regulation for welding, eight points for annealing.

•

Textile Motor

Ventilating system of this new screenless open motor for textile service has been designed with particular attention to



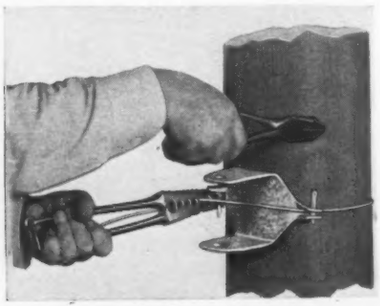
Type K, 324-frame; 10 hp., 1,800 r.p.m., 60 cycles. **General Electric Co.**, Schenectady, N. Y.

positive lint expulsion. Size of the air inlet and discharge openings, smooth contour of the air passages and unique design and location of the fans are said to be the outstanding features of this motor, which is of the squirrel-cage induction type.

•

Pole Fixture

One size of this new one-piece pole fixture is sufficient for its various uses—to carry primary or secondary circuits or to serve as crossarm or guy line attachment.



Utility pole fixture; over-all dimensions, about 5¼x3½ in. **Malone & Lockwood**, Evansville, Ind.

Small in size, it is made of high-strength galvanized steel, with brass cotter key and cadmium-plated wedge to allow bending of the plate without damaging the legs. Company states that it may be attached with a lineman's ordinary belt tools—pliers and connectors.

•

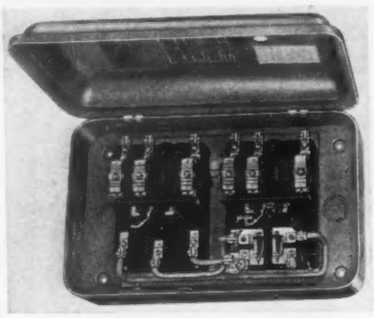
Stockroom Light

"Stocklite"; accommodates lamps of from 50 to 200 watts; for direct mounting on outlet box. **Goodrich Electric Co.**, Chicago, Ill.

This new lighting fixture is intended for use in the narrow aisles of stockrooms and similar places. It reflects light to the sides and produces uniform illumination from top to bottom shelf as well as on shelf surfaces, it is said. Curved, V-shaped flanges at both ends of the reflector deflect light rays to the sides and are designed to eliminate aisle glare.

Motor Starters

Here is a new model in this company's line of remote-control, across-the-line, a.c. motor reversing starters. They are designed to be operated at some remote point by



Type "MR," size 2; 50 amp., voltages from 110 to 600, max. hp. ratings 7½ to 25. **Hart & Hegeman Division, The Arrow-Hart & Hegeman Electric Co.**, Hartford, Conn.

means of a push-button station or other master device. "Stop-reset" button projecting through the cover is primarily intended for resetting the thermal overload relays after they have opened the switch following a sustained overload on the motor, but it may also be used to stop the motor at the starter. Overload protection is provided in either direction with one set of heaters, it is said.

•

Combination Lighting Units

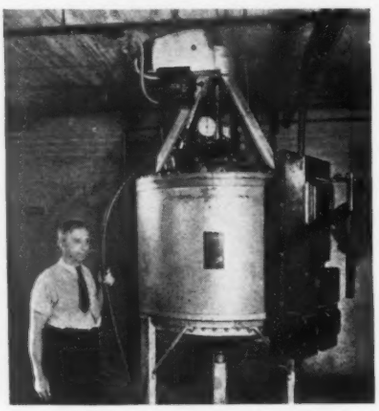
Combination mercury and Mazda lamp lighting fixtures. **Benjamin Electric Manufacturing Co., Des Plaines, Ill.**

New lighting units combine the light from one 250-watt mercury lamp and one 300- or two 150-watt Mazda lamps to produce a soft, diffused light, simulating daylight and considered by many as more pleasing than the light given by either lamp alone. Two types are available; one employs an opal glass-diffusing globe, the other a dome-type reflector with a stippled-glass dust-tight cover at the bottom.

•

Process Kettles

Heating elements of these electrically fired kettles for chemical process work are divided into zones, each zone having individual push-



In sizes of 50 to 1,000 gal. capacity; 40 to 300 kw.; for operation on 230 volts. **Copper Boiler & Heater Works**, Manitowoc, Wis.

button control and automatic overload protection. Kettles are of copper, stainless steel, monel or nickel, depending on their use, and may be operated with either vacuum or pressure.

ENGINEERING DATA FROM MANUFACTURERS

Bulletins and catalogs now available to engineers by manufacturers and associations

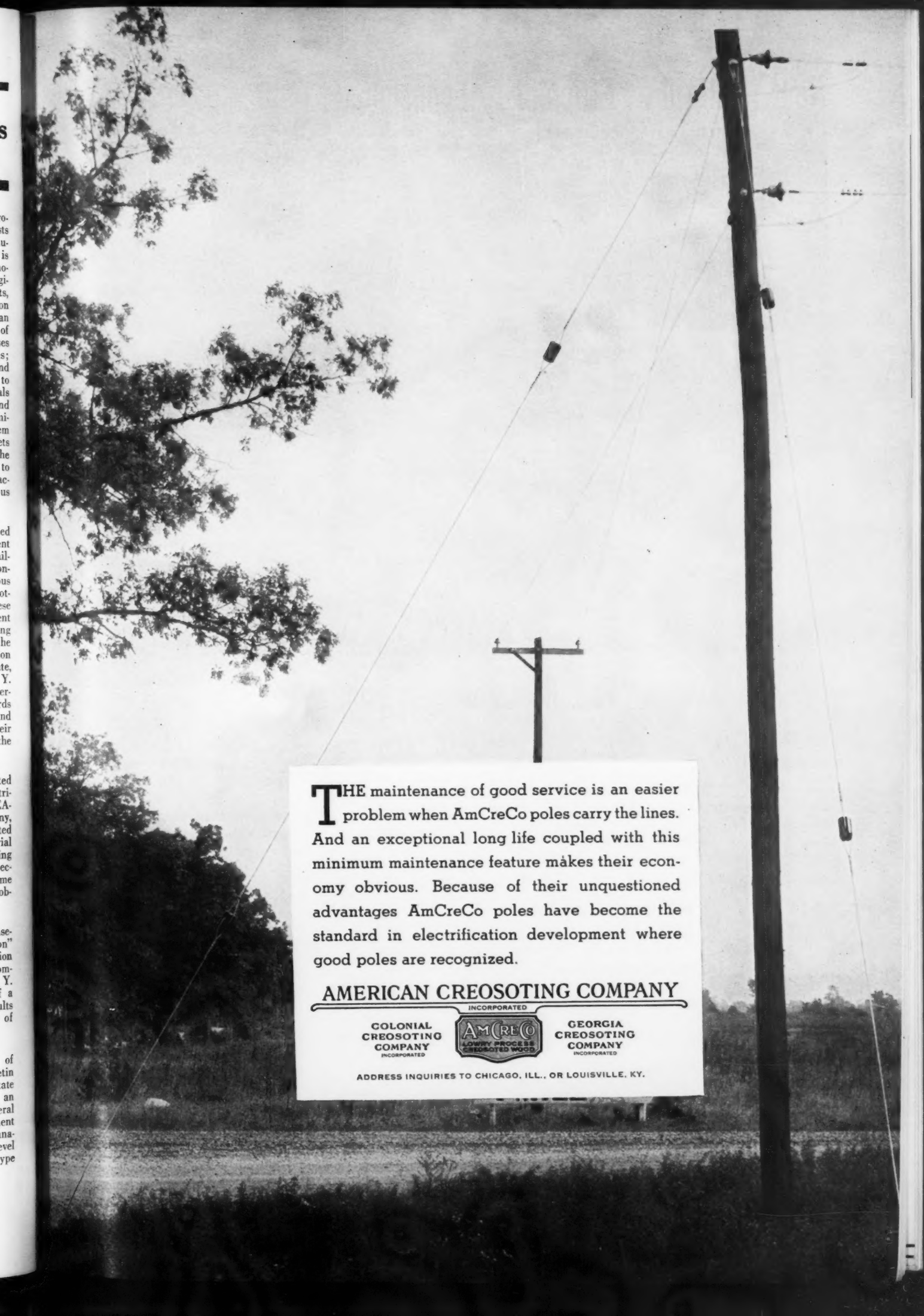
LUBRICATION—Because the Shell Petroleum Corporation receives frequent requests for non-technical information on the manufacture and application of lubricants, it is issuing a series of booklets entitled "Panorama of Lubrication." Dedicated to engineers, executives, salesmen and students, "whose interest in the subject of lubrication demands simplicity," the booklets are of an educational nature. The fundamentals of lubrication are three, they say: The causes and effects of friction in its various forms; the characteristics of lubricating oils, and the proper application of these products to lubrication problems. These fundamentals are presented in perhaps as simple and clear a manner as possible; where definitions are necessary, diagrams make them more easily understandable. Three booklets have been issued so far; they unroll the "panorama" from the history of motion to the solvent-extraction process of manufacture. Copies are available from the various Shell sales offices and representatives.

CABLE OPERATION 1935—"The combined failure rate for all high-voltage equipment in 1935 (total cable, joint and pothead failures per 110 miles of cable per year) continued the downward trend of the previous five years. Failure rates for joints and potheads were the lowest yet reported in these annual studies, being 14 and 24 per cent lower, respectively, than the corresponding rates for 1934." Thus is summarized the detailed information given in publication No. D17 of the Edison Electric Institute, 420 Lexington Avenue, New York, N. Y. Bulletin includes discussion on the performance of and tabulated operating records for high-voltage underground equipment and is priced at 60 cents to members and their employees, $1.50 to non-members in the U. S.

AERIAL CABLE—How to select insulated cable for overhead transmission and distribution is told in the 52-page Bulletin GEA-2215 of the General Electric Company, Schenectady, N. Y. Tables are presented showing current-carrying capacities of aerial cables and also methods of calculating regulation. Discussion is included on selection of insulation, conductor, finishes. Some attention is also paid to installation problems.

CORROSION OF CAST IRON—"Some Consequences of Graphitic Corrosion of Cast Iron" is the title of an eight-page publication offered by the International Nickel Company, Inc., 67 Wall Street, New York, N. Y. The report deals with the mechanism of a type of corrosion of cast iron that results in the formation of a surface layer of residual graphite.

NOISE MEASUREMENTS—The technique of noise measurement is discussed in Bulletin 20 of the General Radio Company, 30 State Street, Cambridge, Mass. Following an introductory consideration of the general subject, material is presented on equipment and standards to be used, and an explanation of the method of making sound level measurements with this company's Type 759-A sound level meter is given.



THE maintenance of good service is an easier problem when AmCreCo poles carry the lines. And an exceptional long life coupled with this minimum maintenance feature makes their economy obvious. Because of their unquestioned advantages AmCreCo poles have become the standard in electrification development where good poles are recognized.

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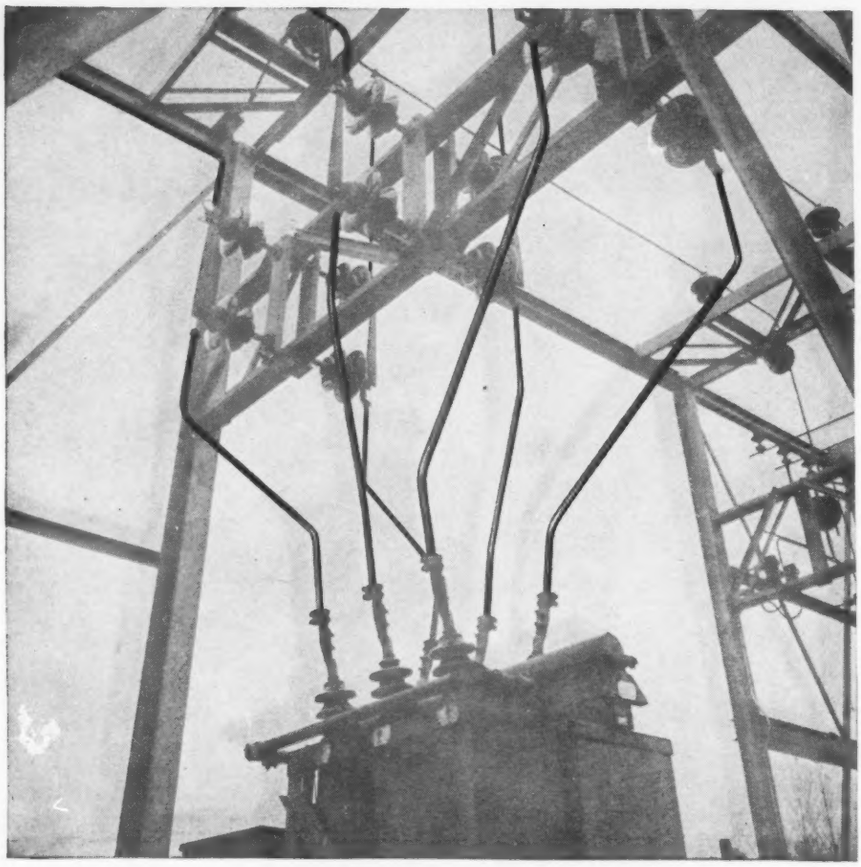
ADDRESS INQUIRIES TO CHICAGO, ILL., OR LOUISVILLE, KY.

Neat . . Rigid . . Efficient . . Economical!



. . *that's why* CHASE Round Copper Tube *is preferred for Substation Buses*

Chase "Thin-Wall" Copper Tube and Fittings actually cost but little more than the usual wire bus construction. Yet they have the advantage of rigidity, of long service life, and make the most efficient use of substation structures.

They are light in weight, easy to install, easy to change. And the rigid tubes maintain the design clearances. "Thin-Wall" tubing can be flattened and drilled for connections. For heavier-duty service, Chase Copper Tube is available in standard and extra-heavy Iron Pipe Sizes.

Let Chase Engineers send you engineering information on Chase products.

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FREE! 40-page Engineering Handbook on Bus Construction.

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Please send me a copy of your publication "Chase Copper Tube for Bus Construction".

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*Subsidiary of Kennecott Copper Corporation

Economic Planning Averts Totalitarian State

[*Continued from page 46*]

sons, when the Chickamauga Dam is drowned out and can supply no power, the Wilson Dam has an abundant supply, while in very low water, when Chickamauga Dam would have little power, the Norris Dam will turn down water and double its power output. Thus these three dams, which taken separately would not be highly profitable investments for power, when they are operated together as a single system will develop more than twice as much prime power as the sum of the three operated separately. That is only the simple beginning of a great system of interrelated dams on the Tennessee River and its tributaries. Taken all together and owned and operated as a single system, a great variety of economies can be secured, and the combined value is far greater than though the different units should be owned and operated separately.

The TVA has under way a great program of soil protection, beginning with interesting and significant research work in fertilizer, and from there extending to co-operation with farmers in intelligent treatment of the soil. That of itself is a long story.

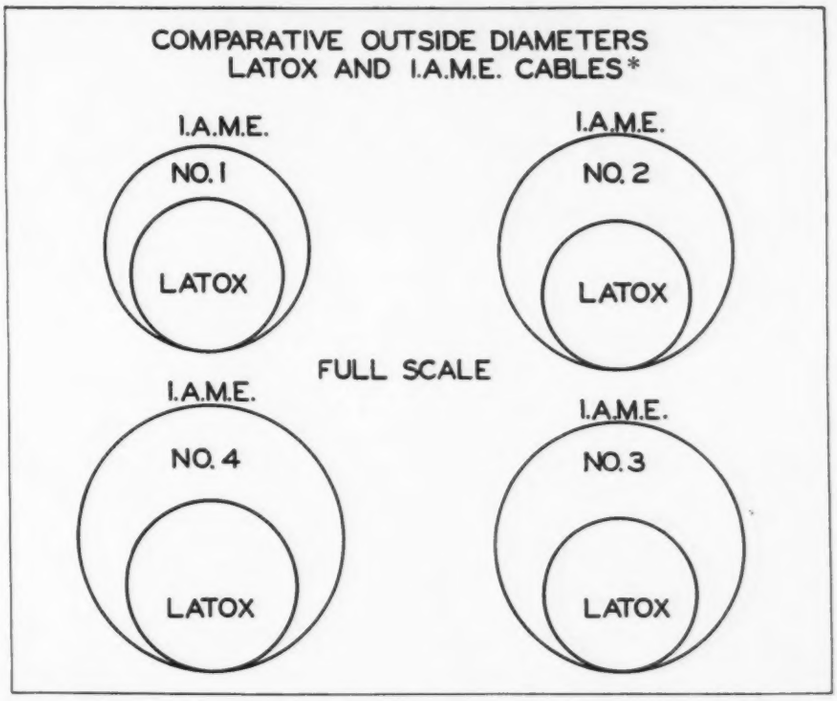
I might describe the destruction of the Southern highland forests, the yearly burning over of the cutover land and the washing away of the soil on the deforested hillsides. I might describe the hopeless despair and poverty in the abandoned sawmill towns where there are no farming possibilities. There we see the reckless destruction of both natural and human resources by private initiative. Social and economic planning is necessary to rejuvenate the forests and to help the people to economic competence. The TVA program in that field is interesting and promising.

Utilities semi-public agencies

Much of the social and economic planning now going on in our country, which we call private business, is not private business, but a sort of private government, somewhat as in old Roman days tax collecting was a part of government which was handed over to private contractors and was looked on as private business.

The modern services I refer to are the utilities, such as gas, water, electricity and the telephone service. They are really a part of government. They

LATOX Cables ARE smaller!



The thin walls of LATOX Cable insulation are like modern steel alloys. A little will do the same job formerly done by a larger amount of bulky material. So with Simplex-LATOX, the walls of insulation are thin in comparison with the bulkier, heavier walls of conventional insulation. Yet Simplex-LATOX will surpass the performance of ordinary material despite the fact that it is only one quarter as thick.

Simplex-LATOX is a high-grade rubber insulation made from latex, prevulcanized in liquid form.

This is a distinct advance over former methods and is added assurance of uniform high quality. This new process is the result of years of research on the development of a rubber insulation having long life, high electrical quality and stability and suitable for application to conductors in relatively thin walls.

The electrical properties of Simplex-LATOX are the best of any known rubber insulating compound. Latox possesses high dielectric strength, high insulation resistance, low dielectric constant and low power factor.

In other words it will do many jobs better than any other type of insulation.

May we send you further information?

*Number of #16 A.W.G. Conductors

Cable #1 – 17 – 2 pairs and 13 singles.
Cable #2 – 20 – 3 pairs and 14 singles.
Cable #3 – 23 – 4 pairs and 15 singles.
Cable #4 – 27 – 5 pairs and 17 singles.

Simplex Wire & Cable Co., Sidney St., Cambridge A, Boston, Mass.

Simplex – LATOX

Thin wall insulation made directly from rubber latex

You'll Have to BUY THERMOGRAY HEATERS

Low Cost Includes Only One Promotion Expense

Here's a complete *factory-built* highest quality electric water heater that sells for less. The Thermogray Company maintains no elaborate and costly sales organization to run your cost up. The retail price includes only your own promotion expense. The fact that you BUY these heaters instead of waiting for a salesman to contact you, enables you to offer your customers a superior product at an attractive low price. Leading utilities have been BUYING and merchandising Thermogray heaters for over 8 years.

Thermogray Heaters Are

BUILT—NOT JUST ASSEMBLED —at the Factory

Thermogray heaters are *precision built* throughout right in our factory. To assure excellent tanks, we build and galvanize every tank. Each piece of mica is accurately tested for uniform thickness. Any piece that varies is rejected. We punch and form the resistor ribbon and build the Thermogray heating element. These dependable, highly efficient heaters are really *manufactured*, not just assembled, at our factory. This is your guarantee of A-1 quality and balanced, trouble-free performance. Sell Thermogray automatic electric water heaters for greater satisfaction at lower prices. Write today for full details.

The top picture shows a Thermogray tank shell being crimped in a hydraulic press at the Thermogray factory. All large Thermogray tanks have elliptical ends for strength.

In the lower picture, mica used in insulating the heating elements is being tested for uniform thickness in a precision gauge at our factory.

THERMOGRAY CO.

303 W. McKINLEY ST. JEFFERSON, IOWA

Thermogray ELECTRIC WATER HEATERS

could not exist and thrive without being given powers of government. They are given power to take private property for their public use. They are given monopoly franchises. They can set non-competitive rates. These are governmental powers. Just as in Roman times the public business of tax collecting was given into private hands, so these public services with their powers of government have been given into private hands.

In the TVA the business of generating and selling electric power is being undertaken to a limited degree by the government as a byproduct of river control. If it is properly administered that can be a very interesting and useful demonstration, as well as a fundamental economy in the use of natural resources. It is very necessary that such public business be honestly and efficiently conducted, without political patronage, with honest and representative accounting and publicity, with fair treatment of necessary and useful private investments, and without wasteful duplication of facilities. It is for the government to say, within constitutional limits, whether these public services are to be provided directly by the government or through semi-private corporations. An honest and fair comparison of public and private administration will be of value in coming to conclusions on that subject.

I have pictured a few phases of social and economic planning in the TVA in which the government may properly be directly interested. There are others I have not discussed. I believe it is proper for the people constantly to appraise the social order with discrimination and to decide from time to time where social and economic planning is necessary by the government itself, and where the best results can be had by private initiative.

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Lansing Awards Contracts

Contracts for more than $1,500,000 of equipment for a proposed new $3,000,000 power plant have been awarded by the Lansing, Mich., Board of Water and Electric Light Commissioners. The following bids were accepted: Two turbine-generators, Allis-Chalmers; two boilers, Babcock & Wilcox; evaporators, Foster Wheeler; condenser, C. H. Wheeler Manufacturing Company, Philadelphia; dust collection apparatus, Research Corporation, New York.

NONE CAN EQUAL KLEINS

The Klein trade-mark is familiar to electricians, linemen, safety engineers, good workmen everywhere. It is a guarantee of maximum quality and maximum satisfaction.

The popular "streamlined" side cutting plier. The Klein line includes pliers for every use — long nose, oblique cutting, flat nose, etc. Send for the Klein catalog and lineman's handbook containing information of value to all electricians.

The honest quality that makes Kleins preferred by electricians and linemen today is the same quality that has been responsible for Klein leadership, "since 1857." Kleins are made from a special alloy tool steel, drop forged and oil tempered. The knives are carefully honed by hand to insure a lasting, sharp cutting edge. Each plier is individually adjusted and individually inspected and tested. The knives must match—the handles must have the proper spring for a tireless grip, and each plier must prove its ability to cut wire easily and to stand up under service far greater than it will ever receive in use. Over years of service no plier is as economical as Kleins. For safety, for ease in use, for genuine, all around satisfaction, master workmen prefer Kleins.

DISTRIBUTED THROUGH JOBBERS

Foreign Distributor: International Standard Electric Corp., New York

Mathias Klein & Sons
Established 1857 — Chicago, Ill. U.S.A.
3200 BELMONT AVENUE

Klein leather goods are made from the first quality "slow process" vegetable tanned harness leather, selected for its strength and durability and checked by chemical analysis and frequent laboratory tensile tests. All "D" Rings, snaps and buckles are drop forged from bar steel. Riveting is done by hand with solid copper rivets. Standard of quality with utility companies, railroads and linemen everywhere.

The new "Klein-Kord" fabric safety strap takes a load of 2,400 lbs. before ripping at the tongue. Of uniform strength and thickness throughout, it will not stretch. Assures long wear and a full factor of safety. Ideal for tower work. Adopted as standard by many public utilities.

Klein Climbers are made in standard weights and sizes, as well as in a "light weight" type for those who prefer. Shanks and gaffs are individually tested to insure perfect riveting and temper. The leg iron is of spring steel. The spur is forged from tool steel. Designed for comfort. Ask the man on the pole. The odds are his climbers are Kleins.

The new Klein improved "Chicago" Grip for electrical conductors or guy work. A universal grip that will take messenger or guy strand from 3/16 in. diameter up to 1/2 in. diameter. May also be used satisfactorily on bare conductors, solid or stranded, from No. 6 to No. 4/0 seven strand copper. Also ideal for A.C.S.R. up to No. 3/0. Bronze-lined jaws prevent slipping and increased leverage assures a sure grip under all conditions with loads up to 8,000 lbs.

Klein Splicing Clamps are made in a wide variety of sizes and styles to fit every purpose. The combination wire and sleeve clamps may be used for twisting bare wire and sleeves. Special styles are carried for telephone and telegraph linemen and power companies, each designed for the sizes most used in its particular field.

Aren't Human Lives worth 60c?

This is the average cost of making a routine "Megger" ground resistance test (experienced by a large user of "Megger" instruments)—to be sure of proper grounding of generating stations, substations, transmission towers, transformers, lightning arresters, etc. The price of protection to human lives and property—of insurance of service continuity.

When you invest many dollars in the best grounding equipment available—isn't it worth these few cents more to *know* that your connections to ground are giving you the protection that you are paying for?

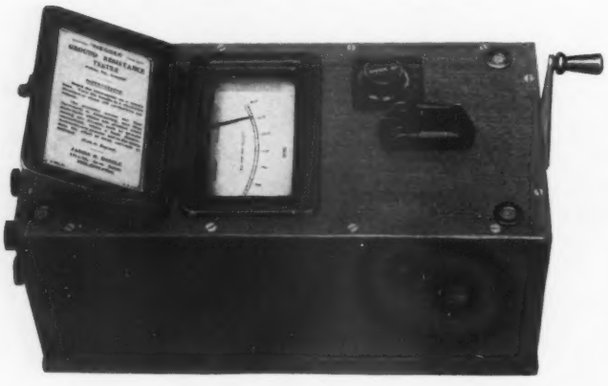
Investigate "Megger" and "Meg" Ground Testing Instruments, that have made the measurement of ground resistance as simple, practical, dependable and economical a practice, as periodic "Megger" testing of electrical insulation.

Catalog 1425-W — Contains complete description of both "Megger" and "Meg" Ground Testing Instruments . . . describes principles of operation . . . offers suggestions as to selection and application for specific purposes. Write for your copy.

JAMES G. BIDDLE CO.

ELECTRICAL INSTRUMENTS

1211-13 ARCH STREET PHILADELPHIA, PA.



"MEGGER"

TRADE MARK REGISTERED U.S. PAT. OFF.

GROUND RESISTANCE TESTERS

Application of Sodium Lighting to the Highway

[*Continued from page 53*]

desirable to turn sodium-lamp circuits on ten to fifteen minutes earlier than the regular schedule.

The approximate electrical data for the 60-cycle multiple-circuit sodium luminaire are as follows: Volts, 115; amperes, 5.2; watts, 255; power factor, 0.43.

The provision of a 20-mfd. capacitor within the luminaire will increase the power factor to about 90 per cent and should be considered if an installation of many units is contemplated.

The possibility of radio interference has been overcome in the design of the luminaries. Thorough tests have shown that the combination of capacitor and choke coil furnished in each sodium luminaire is effective in keeping out of the circuit the radio-frequency components of the "rectangular-wave" voltage that are likely to create disturbance. However, if the open telephone lines will parallel a series aerial lighting circuit, it is recommended that simple precautions to minimize induction be considered in designing the lighting circuit.

Table II—Capacity Table for Type RO Novalux Constant-Current Transformers

Kw. Rating	10,000-Lumen Units With IL Transformers	10,000-Lumen 6.6-Amp. Straight Series Units
3	9	10
5	15	18
7.5	23	27
10	30	35
15	46	53
20	61	71
25	77	89
30	92	107

Estimates of the probable costs of a series sodium highway lighting system are contained in the following table:

Estimated Cost per Mile of Highway Lighting (according to recommendations given with 10,000-lumen sodium lamps):	
Investment:	
Material	$2,600 to $3,400
Labor and overhead	$1,150 to $1,450
Total	$3,750 to $4,850
Operation and Maintenance:	
Material, labor and overhead	$500 to $ 650
Electrical energy kw. demand	4.75 to 6
Kilowatt-hours	20,000 to 25,000
Cost at $0.015 per kw.-hr...	$300 to $ 375
Total	$800 to $1,025
Rates:	
Per mile	$1,550 to $2,000
Per luminaire	$ 70 to $ 80

These estimates contemplate a new wood pole line with aerial wiring, in-

SIT DOWN AND LIST YOUR OFFICE NEEDS

Mail coupon today for complete information. Let Remington Rand supply the office equipment you need. Hundreds of items always in stock. each the latest and best of its kind. Many important and exclusive improvements within the past two years. A complete range of prices to fit the specific job. Deliveries in most cases can be made overnight from nearby warehouse points.

Enjoy the savings that result from large scale operations. Benefit from the invaluable experience Remington Rand has gained in supplying utilities all over the country.

Phone the Remington Rand man in your city or mail the coupon for complete details and description of the items in which you are interested.

SAFE-FILE
for irreplaceable papers

Your most valued paper assets are safe for one hour with Safe-File. Each drawer is a separate insulated compartment. Considered standard equipment for law offices, banks, utilities and places of business where loss of records would mean serious financial loss or delay in resuming operations.

Visible KARDEX *instant signaling for sales, credit, inventory control!*

Cut business costs—increase management efficiency—with Kardex Visible control. Kardex Visible cards, easily posted, assemble widely distributed information. Colored progressive signals indicate day-to-day movement of every important phase of your business. Easily adapted to any control system desired.

KARDEX ON WHEELS. A new Kardex Visible unit mounted in a cabinet on wheels brings records complete and up-to-date, direct to the executive's desk for dictation or discussion. At night, entire unit may be wheeled into the vault for safekeeping.

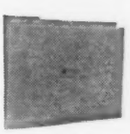
KARDEX *book unit*

No business too small for Kardex Visible control. New zipper book unit, brief case size, holds Kardex cards. Also used for executive summary control makes unique visual presentation.

KARDEX VERTICAL VISIBLE

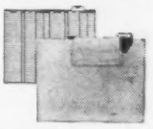
Brings to records the advantages of vertical filing plus visible signal control and finding speed. One glance picks out the account you want. A brilliant colored signal flashes its status, prevents error. On ledgers, speeds up collections.

Every-Day Supplies For Every Office At New Low Prices



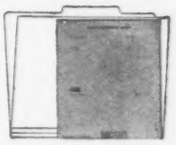
FILE FOLDERS

Manila, kraft, pressboard—with plain, reinforced metal or celluloid tabs.



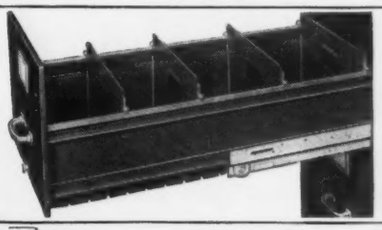
CHARGING SYSTEMS

Simple inexpensive forms to charge out-of-file papers to individuals, preventing loss.



CROSS REFERENCE SHEETS

Standard forms to indicate material filed under another classification.



FLEXIBLOCKS *save file space*

Eliminate space consuming followers. Adjustable along channels at bottom of drawer, holds papers upright for quick and easy reference. For use in all types of Remington Rand files.

OLD WAY

100 folders—10 papers each—use 13" of filing space.

ECONOMY FASTENERS

Kompakt Fasteners, a new invention for heavy duty, save 25 to 60% space of ordinary fasteners. Make a flat neat folder with no rough edges to catch adjacent papers or folders. Scottie Fasteners are most economical for light duty.

NEW WAY

Same material with Kompakt Fasteners need only 7".

MAIL COUPON NOW

Remington Rand Inc. Dept. U-143
465 Washington Street, Buffalo, N. Y.

Please send me complete details on the items checked. ☐ Safe-File; ☐ Visible Kardex; ☐ Kardex Book Unit; ☐ Kardex Vertical Visible ☐ Kardex on Wheels; ☐ File Folders; ☐ Charging Systems; ☐ Cross Reference Sheets; ☐ Flexiblocks; ☐ Economy Fasteners.

Name.....

Firm.....

Street Address.....

City.....State.....

Ok..it's from Remington Rand

PENNSYLVANIA
Rural Line
TRANSFORMERS

. . . with characteristic
Pennsylvania performance

THIS important addition to Pennsylvania's line offers the same assurance of dependability and long life that has characterized every Pennsylvania transformer ever built, and embodies these traditional Pennsylvania advantages:

CIRCULAR COILS . . . which withstand severest short-circuits without injury or distortion.

REINFORCED INSULATION . . . which protects against high voltage surges of steep wave-fronts.

DETACHABLE BUSHINGS . . . which are bolted externally and permit replacement without cover removal.

ROUND STEEL TANKS . . . made of rust-resisting, copper-bearing steel; strong and sturdy.

PENNSYLVANIA TRANSFORMERS

Pennsylvania Transformer Co.
1701 Island Avenue, N. S. Pittsburgh, Pa.

cluding a single-phase power line, and cover a 1-mile section of an installation assumed to run 3 miles or more. They cover the range of spacings from "minimum" to "preferred" in the table of recommendations.

•

Beauty Shop Equipment Valued at $10,562,219

The beauty shop has a place as a consumer of electrical equipment. Newly constituted for Census purposes as a separate industry in the Census of Manufacturers of 1935, production of beauty shop equipment was valued in that year at $10,562,219, according to a preliminary announcement. Only a portion of this was electrical, however. Permanent waving machines amounted to $3,339,934; hair dryers, $2,320,430. Hair curlers are included in a general item "Other Beauty Shop Equipment," totaling $1,680,045.

The classification does not cover the manufacture of certain classes of equipment such as sterilizers, that are used also by dentists, physicians and hospitals. Corresponding statistics for earlier years are not available.

•

English Town to Try Vapor Street Lights

A town in Central England is to institute an experimental street-lighting program using mercury vapor lamps for general illumination and sodium lamps to indicate crossings and corners. The suggestion by the Royal Automobile Club that a standard method be adopted throughout the country if the idea is approved has been referred to the Departmental Committee on Street Lighting by the Ministry of Transport.

•

Ireland to Harness Liffey

Tenders for the work of developing the River Liffey for the supply of potable water and electric power have been invited by the Irish Free State Electricity Board. These will be ready for consideration by the end of March. It is estimated that the cost of the complete scheme will be more than £1,000,000 ($5,000,000).

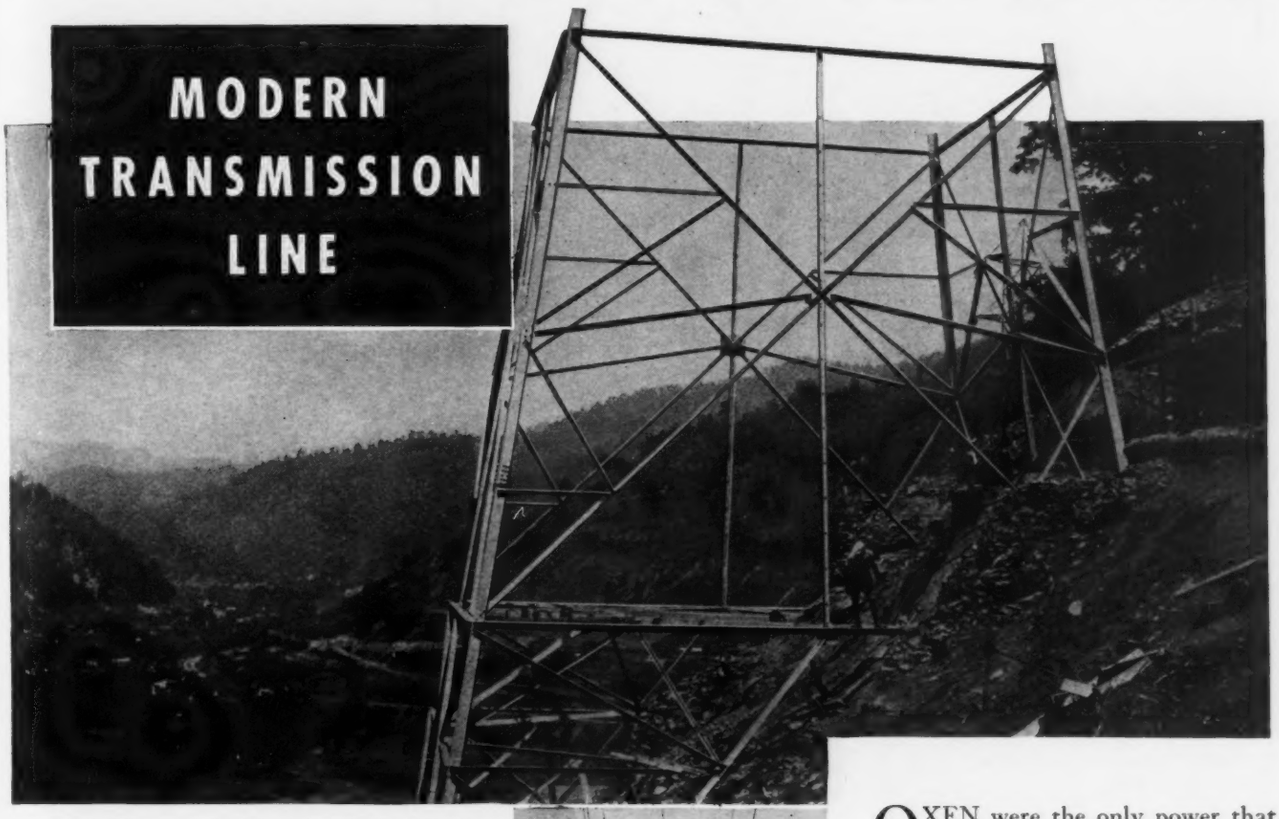
•

Gain in G. E. Stockholders

There were 190,044 stockholders of General Electric Company as of November 27, 1936, as compared with 185,744 on December 27, 1935.

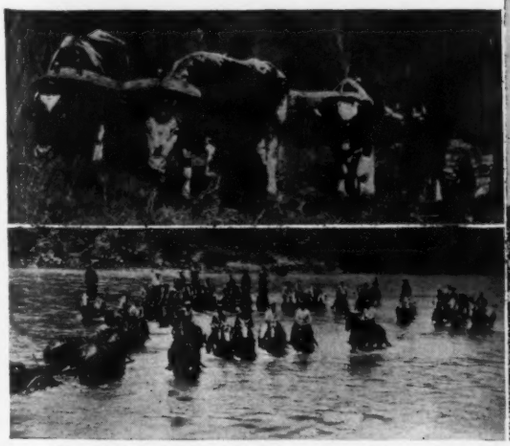
Ancient Power used to Build

MODERN TRANSMISSION LINE

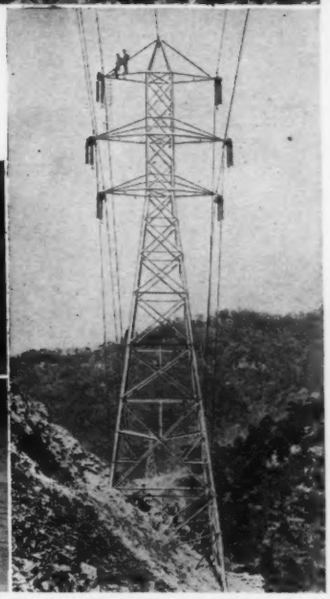


Each side-hill site presents a different problem of engineering and construction.

This three-yoke ox-team sledged some of the tower steel up the hillside, while an occasional long, steep drag required as many as twenty yokes of oxen to transport the material.



The tower delivery crew take to the water, fording the Guyan River in West Virginia.



This 132 K. V. line was constructed by the Appalachian Electric Power Company of West Virginia.

OXEN were the only power that could transport the materials for this transmission line when it swept through virgin terrain, paying no attention to ridge or valley, forest or stream. In the construction of this line across the mountain ranges of West Virginia, some of the tower sites could not be reached in any other way. It was necessary to hew a path through dense woods and ford unbridged streams. Thus each tower presented its own engineering and construction problem, to be reckoned with in advance by the engineers.

American Bridge Company engineers have encountered many such unusual problems and accumulated a fund of highly useful experience which can be drawn upon for your particular needs.

AMERICAN BRIDGE COMPANY

General Offices: Frick Building, Pittsburgh, Pa.

Baltimore · Boston · Chicago · Cincinnati · Cleveland · Denver · Detroit
Duluth · Minneapolis · New York · Philadelphia · St. Louis

Columbia Steel Company, San Francisco, *Pacific Coast Distributors* · United States Steel Products Company, New York, *Export Distributors*

UNITED STATES STEEL

GET THE FACTS!

About . . .

DIAMOND VULCANIZED FIBRE

Diamond Vulcanized Fibre is probably the most versatile laminated fibrous insulating material, because it offers an unique combination of desirable properties. It is an extremely tough material which will stand any amount of abuse without serious damage, yet has good electrical insulating properties only slightly affected by moisture. It is readily fabricated by all common methods and is therefore an extremely economical material whether the need be for one part or a thousand parts.

The Diamond Vulcanized Fibre catalog illustrated above gives complete technical data, describes many of the countless uses of this versatile material, and tells how it is best and most easily fabricated. You should have a copy at your elbow for ready reference. Send for it today.

CONTINENTAL-DIAMOND FIBRE COMPANY

NEWARK DELAWARE

Public Relations Audit Checks Customers' Relations

[*Continued from page 58*]

company. A group of service tags were selected at random and the customer called on the telephone and asked if the work was done to his satisfaction. If the customer expressed doubt or dissatisfaction a "call-back tag" was issued immediately and another service call made. That this check may have some effect upon the quality of the service work done by the organization is indicated by the fact that the number of call-back tags issued decreased 38.75 per cent in one year's time.

Results obtained

In general, some of the benefits enjoyed by the company since the inauguration of the public relations audit plan are:

1. It afforded an opportunity for a customer who might have been harboring a contention against the company to express his feelings and, if possible, have the difficulty corrected. The psychological effect of this on an irate customer has often changed a critical attitude to a friendly one.

2. It has provided the opportunity to correct erroneous impressions largely due to misinformation and which were influencing customers adversely.

3. It permitted explanation of the company's service policies for appliances which evidently were unknown to a large number of customers. Many had appliances which were broken and causing complaints, yet the customer had not utilized the facilites of the appliance maintenance service.

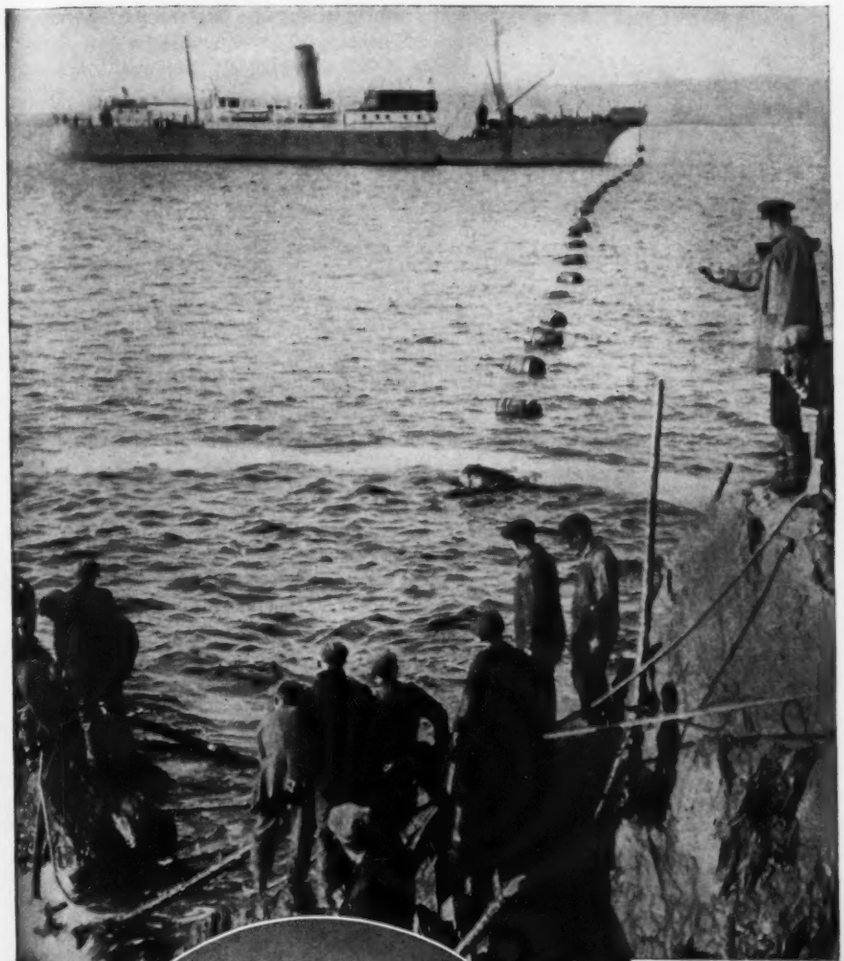
4. Poor service conditions, radio complaints and other details are brought to light much more rapidly than before and the quick relief afforded the customer by the company has proved to be an impressive good will builder.

5. Customer suggestions have resulted in greater efficiency in local office organizations by directing attention to the convenience certain consolidation of functions, etc., could afford.

6. There has been a general beneficial effect on the whole organization, leading them to closer attention and stimulating their work to give the customer greater satisfaction.

The success of the plan relies upon

Out of the Depths!

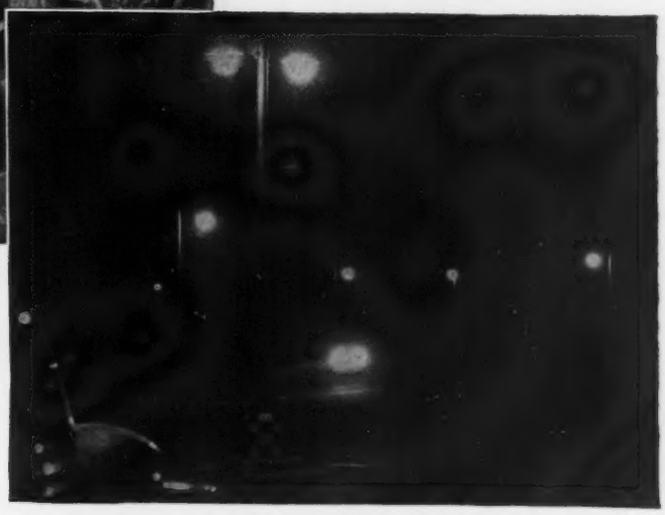


OUT of the depths of the sea!

Out of the depths of many years of experience and operation comes that knowledge and background that enables us to produce the most reliable—most satisfactory Non-Metallic Trench Cables.

Hundreds of miles of Non-Leaded Submarine Cable have been installed and operated over the past 30 years. Each length is subjected to water—cold and warm, fresh and salt. Each length has its shore end buried in the ground. Each length is a forerunner of the more modern Triple "L" Non-Metallic Trench Cable.

American Steel & Wire Company Triple "L" Non-Metallic Trench Cables are available in single, twin and multiple conductor constructions and in all sizes for any voltage. The conductor insulation is our Amerite Rubber, having low water absorption—perfect aging characteristics and is in daily operation at voltages up to 13 KV. Fibrous fillers are eliminated and replaced by an integral sheath and fillers of acid, alkali and water resisting compound.



AMERICAN STEEL & WIRE COMPANY

208 S. La Salle Street, Chicago

Columbia Steel Company, San Francisco, *Pacific Coast Distributors*

Empire State Building, New York

United States Steel Products Company, New York, *Export Distributors*

UNITED STATES STEEL

Reliable STRAIGHTLINE DEADENDS

WITH RUGGED CLEVISES FOR NEAT, CONVENIENT, and ECONOMICAL INSTALLATIONS

For use with standard disk type insulators. Also used with uninsulated eye bolts terminating neutrals on rural construction.

Hold copper wire, hard, medium, or soft drawn, to approximately full strength.

The wire holding mechanism is the same as that proved so successful in the Reliable Straightline Splice. The jaws forming this mechanism ride in slots of a husky washer and cannot slip out of place to cause trouble upon insertion of wire.

Illustrating how jaws ride in slots of husky washer and maintain proper spacing for positive performance.

Reliable Straightline Deadends are also available for use with galvanized steel conductors.

End of tube dampens vibrations before they reach clamping jaws. The husky, reinforced clevises are equipped with cotters designed for easy handling by a lineman wearing gloves.

Easily reclaimed. Clevises have a large margin of strength over field requirements — they are small enough to make a neat installation.

WRITE FOR BULLETIN

Reliable ELECTRIC COMPANY

OVER 25 YEARS SERVICE TO THE UTILITIES

3145 CARROLL AVENUE • CHICAGO ILLINOIS

the accuracy of the information obtained and the methods of making it available for use promptly. Inspection of the accompanying chart shows how compactly a valuable amount of information can be tabulated for ready reference. Thereon will be found the seventeen classes of complaints as found on each division of the system for two years. Percentage figures on increases or decreases, comparison between divisions and a cross-section of customer opinion of the service are available at a glance and unwarranted increases in certain types of complaints are easily picked up and remedial measures adopted. The company does everything in its power to render friendly, courteous and adequate service—the audit tells how the customers view those efforts.

•

Electrify Osoyoos Mines

Osoyoos Mines, Ltd., recently placed an electrical contract with the Reston Electric Company, Vancouver, for the electrification of its property at Osoyoos, B. C. The West Kootenay Power Company has completed building a 20,000-volt transmission line from Oliver to Osoyoos and has installed a step-down transformer station near Osoyoos Mines.

•

Trackless Trolleys

A fleet of seven trackless trolleybuses, the first in Canada, has arrived in Montreal. Built in England for the Montreal Tramways Company, the buses are equipped with double trolley poles and each weighs slightly more than 9½ tons.

•

Warren Telechron

Warren Telechron Company of Ashland, Mass., has launched a broadside of consumer advertising in national publications which will be supplemented by special clock and other advertising.

•

Kelvinator Shipments

Unit shipments of all Kelvinator refrigeration products for February totaled 31,287 units, a gain of 6 per cent over a year ago. Shipments for the first five months of the fiscal year beginning October 1, 1936 were up 38.8 per cent over the preceding period. Unit shipments were 122,653, against 88,378.

A new door to PROFIT

Open it up and here is what you find: *planned application of power to machines by modern methods is a major factor in production economy.* You open this new door to profit when you install planned power transmission. What you save thereby in power costs is a net profit. What you gain thereby in production at decreased cost is a competitive advantage.

★ ★ ★

Modern Group Drive is planned power transmission predicated on the production problem of the particular plant. It is the *newer,* and properly applied, the more *efficient* of the two modern systems of power transmission—individual motor drive (a motor for each machine) and modern group drive (one motor for a group of machines). A Modern Group Drive Plan combines the advantages of both systems; recognizes the need of individual motor drive for certain single machines; specifies modern group drive where machines doing similar or progressive work should be grouped.

Modern group drive costs less to operate and maintain, and much less to install. You buy larger, more efficient motors with better power factor. You pay from 35% to 85% less per motor horsepower. And you need less horsepower for a given number of machines.

SEND FOR FREE BOOKLET

Our Red Book talks your language and tells with pictures and brief text why and where Modern Group Drive is more efficient and economical. Send for a copy today. Case studies are also yours for the asking. And at your call, without obligation, are Power Transmission Counselors throughout the country who co-operate with plant, consulting and public utility engineers in the modernization and installation of industrial power transmission systems.

POWER TRANSMISSION COUNCIL
75 STATE STREET · BOSTON, MASSACHUSETTS

A research association of producers and distributors of power, power units and mechanical equipment for transmitting power.

MODERN GROUP DRIVE

—the *new* efficient and economical way of transmitting power to machines

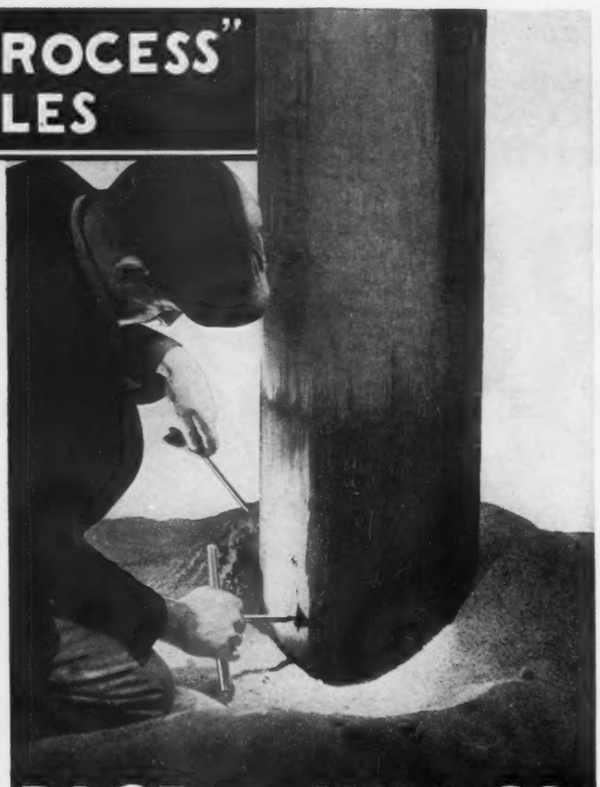
"P&H PROCESS" POLES

FIELD TESTS PROVE THEIR LONG LIFE

Cedar poles for all requirements... Northern White or Western Red Cedar. Fast shipping service.

P&H

"Still in the Lead"



PAGE AND HILL CO.
MINNEAPOLIS, MINN.

CEDAR IS THE NATURAL POLE WOOD

"ACCURATE"
"CONVENIENT"
"A TIME SAVER"

says CENTRAL MAINE POWER

"We have had our Tong Test for a number of years and have found it very useful in making tests on power circuits in industrial plants and for measuring current in our distribution lines. We have found this instrument to be quite accurate and certainly it is a time saver. The convenience of making current measurements cannot be estimated too highly. We might add that, due to our recommendations, a number of our industrial customers have purchased Tong Test meters for use in their plants."

The Tong Test bulletin describes how these ammeters measure A.C. or D.C. instantly, accurately and without interruption to current flow. Write for a copy.

4529 Hamilton Ave. COLUMBIA ELECTRIC MFG. CO. Cleveland, Ohio

Outside United States and Possessions: Crompton Parkinson, Ltd., London, W. C. 2

TONG TEST AMMETERS

Recent Rate Changes

MADISON GAS & ELECTRIC COMPANY has announced a $37,000 annual cut in electric rates, effective with May 1 meter readings, consisting of a quarter-cent reduction on each of the first 50-kw-hr. used monthly.

WASHINGTON WATER POWER COMPANY has voluntarily filed reduced commercial and residential lighting schedules to go into effect May 1, amounting to a $141,000 annual reduction. New commercial lighting rates in Spokane will be: First 18 kw.-hr., $1; next 82 kw.-hr., 5 cents; next 300 kw.-hr., 4 cents; next 1,750 kw.-hr. at 3 cents, and all excess at 2 cents. New residential rate: First 13 kw.-hr., 70 cents; next 22 kw.-hr., 5 cents; next 105 kw-hr., 3 cents; all in excess at 2 cents.

CLEVELAND ELECTRIC ILLUMINATING COMPANY has made a rate reduction designed to save 282,000 customers in five northern Ohio counties some $900,000 a year. New rates: 4 cents a kw.-hr. for the first 240; next 50, at 3.5 cents; next 100 at 2.75 cents and finally 1.5 cents for each kilowatt-hour over 200 a month.

LAWRENCEVILLE, GA.—City Council has authorized a residential rate reduction; new rate is to be 10 cents per kw.-hr. for the first 10; next 60, at 4½ cents; next 130 at 2 cents and all over 200 at 1½ cents.

DAYTON, OHIO—City Council has passed a new power and light rate schedule, designed to save consumers some $215,000 a year. Rates increase minimum charge from 50 to 75 cents, decrease cost to large consumers.

UTAH POWER & LIGHT COMPANY announced a one-cent reduction in the price per kilowatt-hour of power for lighting and small appliances, effective April 1, designed to save some 49,000 consumers an estimated $152,000 annually. Under the new rate consumers in cities over 15,000 will pay a minimum charge of 90 cents for 11 kw.-hr.; top rate of 5 cents per kw.-hr. for first block of 75 kw.-hr. and 4 cents for all additional service. In cities under 15,000 and in rural territory the new rates will be, after a minimum charge of $1 for the first 11 kw.-hr.; 6 cents per kw.-hr. for first block of 75 kw.-hr. and 4 cents for additional service.

FALL RIVER ELECTRIC LIGHT COMPANY reduced domestic and commercial rates on April 1 with the approval of the Massachusetts commission an estimated total of $115,000. New domestic rates: First 15 kw.-hr. at 6.5 cents; next 15 kw.-hr. at 6 cents.

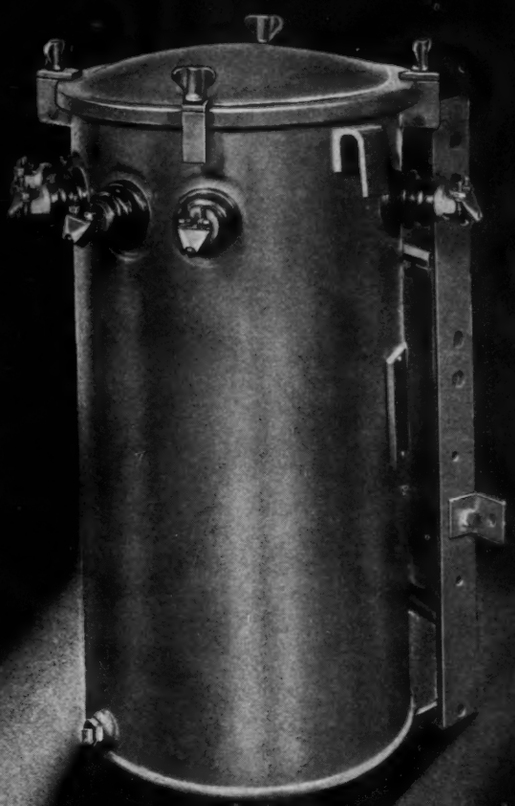
•

Aerovox Canada, Ltd., Gains Control of Polymet Delta

Control of the former Polymet Delta Company of Hamilton, Ont., has been taken over by Aerovox Canada, Ltd., producing a line of Aerovox dry and wet electrolytic condensers, also mica and paper condensers for the Canadian trade.

The Canadian condensers are being made in accordance with the engineering and production standards of the Brooklyn, N. Y., plant, according to proration.

Wagner DISTRIBUTION TRANSFORMERS



At the right is shown a new Wagner 15-kva, 2400-volt, type HEB stud-bushing-type distribution transformer. It has coordinated bushings and insulation and is self-protecting against lightning and, therefore, inherently a surge-protected transformer.

Whatever your distribution transformer requirements may be for the proper and economical distribution of electric power, whether in urban or rural regions, there's a Wagner transformer ideally suited for each job. Wagner distribution transformers are manufactured in all commercial frequencies and voltages in sizes 1½ to 500 kva.

Write today for Wagner's BIG Distribution Transformer Bulletin #180.

Wagner Electric Corporation

6400 Plymouth Avenue, Saint Louis, U.S.A.

TD 237-48

TRANSFORMERS + MOTORS + FANS + BRAKES

U. R. C.
Weatherproof
Wires and Cables

as made by

ROME-CABLE
ROME, N.Y.

meet every
requirement for

R. E. A.
projects

Write for a copy of
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Philadelphia

Municipal Plants

DE LAND, FLA.—A proposed issue of $498,000 in revenue certificates to finance a municipal power plant was turned down recently by free-holders by a vote of 653 to 357. The PWA had agreed to provide a grant of $117,000 and a loan of $351,000 for the plant.

COEUR D'ALENE, IDAHO—City Council has awarded the contract for construction of the municipal power system to Fairbanks, Morse & Company, low bidder at $295,000. The project contemplates a Diesel generating plant and a distribution system to serve a portion of the town. Actual construction will be delayed, however, awaiting the outcome of litigation. Suit was filed in district court by five citizens seeking to enjoin and restrain the city from proceeding with the project on the grounds that the plant would be inadequate to supply the city, that due to rising prices the allotted sum would not be sufficient and that the PWA assistance which was expected when the voters approved the project is no longer available.

TRENTON, MO.—In a memorandum opinion handed down in federal court Judge Merrill E. Otis dismissed a bill of complaint of tne Missouri Public Service Corporation which sought to prevent the city from continuing construction of a municipally owned light and power plant in competition with the company's plant. Judge Otis also dissolved a temporary injunction, effective May 1. The bill of complaint named Fairbanks, Morse & Company, the Baum Bernheimer Company and the city of Trenton from proceeding in construction of the power plant. The complainant alleged it held an exclusive franchise and that Trenton officials did not comply with Missouri laws in advertising for bids and awarding the construction contract.

CAMDEN, N. J.—Senator Burling, Republican, has introduced a bill which would create a Camden power commission with authority over a Camden power district. The commission would have wide powers, including the right to condemn the existing Public Service plant and any other property "necessary or convenient for its corporate purposes." Authority also would be given the commission to borrow money and issue bonds. Earlier in the session Assemblyman Sheehan, Camden Democrat, was sponsor of a measure which would permit municipalities to exceed their debt limit to construct revenue producing improvements (ELECTRICAL WORLD, April 10, page 118). Since Camden already has exceeded its debt limit the measure would have given the city authority to proceed with the proposed plant. This measure is now ready for an Assembly vote.

ADAMS, WIS.—Wisconsin Power & Light Company has appealed in Dane County Circuit Court orders of the state Public Service Commission fixing valuations of $30,000 on the company's Adams electric plant and $13,000 on the Friendship plant. Both communities desire to acquire the plants as municipal utilities.

•

Air Unit Installed in Mine

Installation in the Magma Copper Mine at Superior, Ariz., of the first mine air-conditioning system with mechanical refrigeration in the United States has been announced by Willis H. Carrier. Speaking before a joint meeting of the Air Conditioning Bureau, the American Metallurgical Society and several other engineering groups at the Chamber of Commerce Building in Boston, Mr. Carrier outlined the installation work necessary in placing the equipment at the 3,600- and 3,400-ft. levels in the mine. The system was designed by the Carrier Corporation of Newark, N. J.

•

Third New Factory Unit

Arrow, Hart & Hegeman Electric Company, Hartford, Conn., has taken bids on general contract for new two-story addition, 64x130 ft., at its local South Works on Broad Street and began work on superstructure early this month. This makes the third new factory unit at the plant during the past year, with total cost in excess of $250,000. Mylchreest & Reynolds, Hartford, are consulting engineers.

•

Utility Increases Wages

Announcement was recently made by the Kansas City Power & Light Company of an 8-cent-an-hour increase in pay for 2,000 employees. The increase applies to all employees in all classifications, including hourly and monthly paid persons. The increase, which followed conferences between employee representatives and the management, will add approximately $275,000 annually to the total payroll.

•

Line Material to Buy Plant

Line Material Company, South Milwaukee, Wis., has started negotiations for the purchase of the plant it occupies at Birmingham, Ala., which, if successful, will be expanded.

•

To Build Large Addition

American Transformer Company, Newark, N. J., has concluded arrangements for purchase of property at 273-301 Emmett Street, comprising over one acre of land, and will use as a site for new addition to plant, consisting of several one-story units, equipped to double approximately present plant capacity. Work on superstructures is scheduled to begin soon. Thomas M. Hunter, president, stated the company had experienced a great increase in business and has outgrown its present quarters.

Already On
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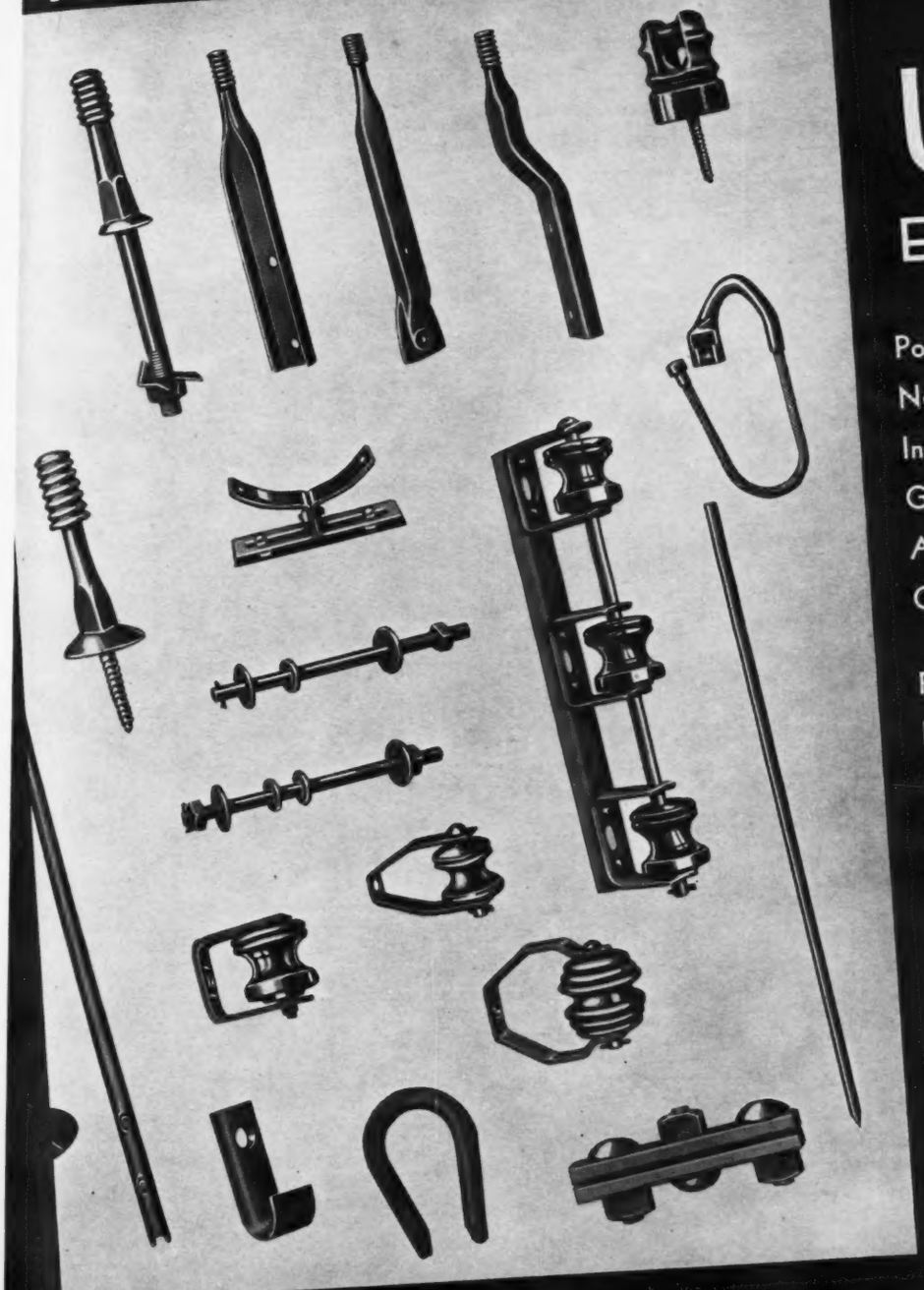

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Neutral Thru Bolts . .
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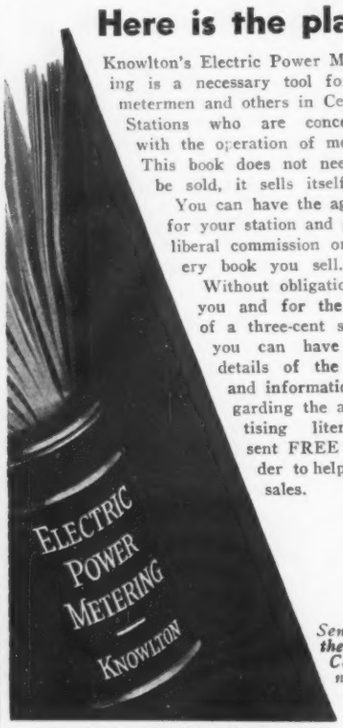

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W4-24-37

Sales Opportunities

WHEELING, W. VA.—Wheeling Electric Company has plans under way for new power substation at Fifteenth and McCulloch Streets, East Wheeling, for which superstructure is scheduled to begin in May. Cost about $250,000 with transformers, switchgear, regulators, power feeders and connections, and other equipment. Company is a unit of American Gas & Electric Company, 30 Church Street, New York, N. Y., and engineering department of last noted company is in charge.

LAFAYETTE, IND.—Aluminum Company of America, Inc., Gulf Building, Pittsburgh, Pa., plans installation of motors and controls, regulators, transformers and accessories, electric hoists, conveyors and other equipment in new multi-unit mill at Lafayette for production of aluminum tubing, extruded aluminum products and allied specialties. Cost reported close to $3,000,000. This is part of expansion and development program authorized by company, with gross expenditure of $26,000,000 for new plants and extensions in present plants in different parts of country.

GREENVILLE, TEX.—Hunt-Collins Electric Company, Greenville, recently organized, plans primary and secondary lines for rural electrification in parts of Hunt, Collins and Fannin Counties, totaling about 175 miles, with outdoor power substation and service facilities. Work is scheduled to begin soon. Fund of $170,000 has been secured through Federal aid.

KNOXVILLE, TENN.—Director of Purchases, Tennessee Valley Authority, Knoxville, receives bids until May 10 for designing, furnishing and delivering two oil pressure governor systems for controlling speed of two 48,000-hp. vertical hydraulic turbines at hydroelectric power plant at Pickwick Landing Dam.

GROESBECK, TEX.—Limestone County Co-operative Electric Company, Groesbeck, plans call for bids early in May for construction of primary and secondary lines, for rural electrification in parts of Limestone and Falls Counties, totaling over 200 miles, with outdoor power substation and service facilities. Fund of $250,000 has been arranged through Federal aid. William G. Morrison, Professional Building, Waco, Tex., is consulting engineer.

NEWCASTLE, IND.—Public Service Company of Indiana, Traction Building, Indianapolis, Ind., is considering new power substation on Avenue I, Newcastle, to cost about $150,000, with transformers, switchgear and accessory equipment. Proposed to begin work in the summer. New unit will adjoin present substation of company at location noted.

ST. LOUIS, MO.—Owens-Illinois Can Company, Ohio Building, Toledo, Ohio, a unit of Owens-Illinois Glass Company, same address, plans installation of transformers and accessories, motors and controls, regulators, electric hoists, conveyors and other equipment in new multi-unit metal container-manufacturing plant at St. Louis, where large tract of land has been acquired. A steam-electric power plant will be built for factory service. Cost close to $500,000. Francisco & Jacobus, 511 Fifth Avenue, New York, N. Y., are architects and engineers.

TIFFIN, OHIO—North Central Rural Electric Co-operative, Inc., recently organized, care of Ohio Farm Bureau, Chestnut and High Streets, Columbus, Ohio, has plans nearing completion and will take bids soon for primary and secondary lines for rural electrification in group of townships in Seneca and Crawford Counties, totaling about 270 miles, with outdoor power substation and service facilities. Fund of $270,000 has been secured through federal aid. Organization has negotiations under way for additional federal financing in amount of $800,000 for additional rural electric lines in neighboring territory.

LANDON, MISS.—Mississippi Power Company, Gulfport, Miss., plans early construction of new transmission line from point near Mississippi-Alabama state line, where connection will be made with system of Alabama Power Company, to vicinity of Landon, about 45 miles. New high-tension outdoor power substation will be built at latter point, with transformers and auxiliary equipment for reducing voltage to 20,000 volts for coast transmission system of Mississippi company, which will be connected with Landon substation. Right-of-way is being secured.

BELLEVUE, IOWA—United States Engineer Office, Clock Tower Building, Rock Island, Ill., asks bids until May 7 for power, control and lighting system for Lock and Dam No. 12, Mississippi River, near Bellevue, including lock lighting system transformers, regulators, switchboard, etc.; incoming line transformers, remote control switch cabinets, lock grounding system, dam conduit system, dam power feeders and connections, lock lighting system, navigation lighting system, service bridge lighting system, storage yard lighting system, portable lighting units, signal system, etc.; gasoline-electric standby power unit, two electric tow-haulage units, two hand-operated traveling bridge cranes; central control station service power and lighting system feeders, pumping units, etc. (Circular 193).

CHEROKEE, ALA.—Cherokee County Electric Membership Corporation, Cherokee, has plans maturing for primary and secondary lines for rural electrification in parts of Cherokee and Dekalb Counties, totaling about 225 miles, with outdoor power substation and service facilities. A steam-electric power plant will be built for power supply. Fund of $310,000 has been secured through Federal aid.

LAKE CHARLES, LA.—Swift & Company, Union Stock Yards, Chicago, Ill., meat packer, plans installation of motors and controls, regulators, transformers and accessories, loaders, electric hoists, conveyors and other equipment in new multi-unit packing plant at Lake Charles. A power house will be built. Bids for building erection are being asked. Entire project will cost about $550,000.

DENVER, COLO.—Bureau of Reclamation, Customhouse, receives bids until May 10 for 10 motor-driven gate hoists for operating 50x50-ft. regulating gates to be installed in spillways at Bartlett and Morman Flat Dams, Salt River Project, California-Arizona. (Gate hoists will be installed by government.) (Specifications 731.)

ZUMBROTA, MINN.—Goodhue County Co-operative Electric Association, Zumbrota, care of George F. Schwartau, Court House, Red Wing, Minn., secretary, has plans maturing for primary and distributing lines for rural electrification in parts of Goodhue, Wabasha, Rice, Dakota and neighboring counties, totaling close to 375 miles, with outdoor power substation and service facilities. Proposed to begin work later this spring. Fund of $377,000 has been secured through federal aid.

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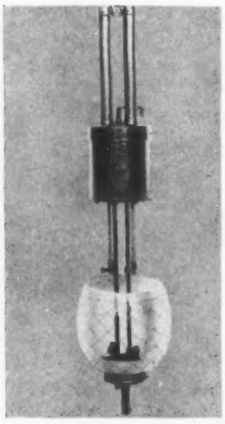

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Simplified Protection of Grounding Transformers

[*Continued from page 51*]

whole system as viewed from the fault location. Usually Z_0 is large compared with Z_1 and Z_2, therefore the currents flowing in the three overcurrent relays with a line-to-line-to-ground fault are approximately the same as with a line-to-line fault at the same location.

From Fig. 3 it is easily seen that of the currents flowing in the overcurrent relays only one may be equal to zero, excepting, of course, when I_1 and I_2 are both zero (no internal fault in the grounding transformer), in which case the three currents are all equal to zero. It follows that of the three overcurrent relays shown in Fig. 2 only two are essential, and one could be eliminated without decreasing the degree of protection. Three relays have been shown in Fig. 2 because overcurrent relays are usually cheap and the third relay adds a certain degree of back-up protection.

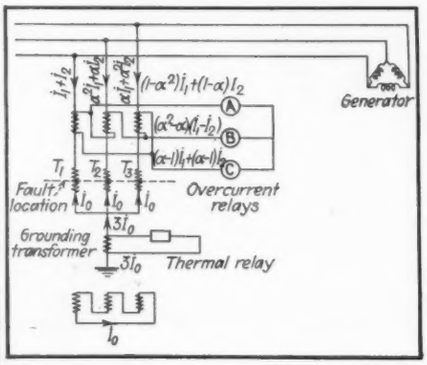

Fig. 2—Compare this plot of currents in the overcurrent relays with the classified data in Fig. 3

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Census Prime Movers Data Not Available This Year

Figures on the horsepower of prime movers, steam, water, internal combustion and electric generators and motors in manufacturing plants in the United States will not be available in the 1935 report of the Bureau of Census. This information has been available in the past at intervals of two to five years in reports of the Census of Manufactures.

Despite growing industrial use of power and recent modernization no information has been obtainable since 1929. It is expected that the earliest power figures will be those of the census for 1937, for which reports will normally begin to appear toward the end of 1938.

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Lincoln Issues Prize Rules

Rules and conditions governing the $200,000 prize contest of the James F. Lincoln Arc Welding Foundation have been issued. The contest is open to any person or group who wish to submit descriptions of welding applications. Copies may be obtained from the Foundation in Cleveland, Ohio.

Type of Fault	Values of Positive and Negative Sequence Currents	Overcurrent Relay Currents *		
		A	B	C
General Case	$\dot{I}_1 \neq \dot{I}_2 \neq 0$	$(1-\alpha^2)\dot{I}_1+(1-\alpha)\dot{I}_2$	$(\alpha^2-\alpha)(\dot{I}_1-\dot{I}_2)$	$(\alpha-1)\dot{I}_1+(\alpha-1)\dot{I}_2$
Line to Ground	$\dot{I}_1=\dot{I}_2=\frac{\dot{E}}{\dot{Z}_0+\dot{Z}_1+\dot{Z}_2}$	$3\dot{I}_1$	0	$-3\dot{I}_1$
Line to Line	$\dot{I}_1=-\dot{I}_2=\frac{\dot{E}}{\dot{Z}_1+\dot{Z}_2}$	$j\sqrt{3}\,\dot{I}_1$	$-j2\sqrt{3}\,\dot{I}_1$	$j\sqrt{3}\,\dot{I}_1$
Line to Line to Ground	$\dot{I}_1=-(\dot{I}_0+\dot{I}_2)=\frac{\dot{E}}{\dot{Z}_1+\frac{\dot{Z}_0\dot{Z}_2}{\dot{Z}_1+\dot{Z}_2}}$	$j\sqrt{3}\,\dot{I}_1+\frac{(1-\alpha)\dot{Z}_2\dot{I}_1}{\dot{Z}_0+\dot{Z}_2}$	$-j2\sqrt{3}\,\dot{I}_1 j\sqrt{3}\frac{\dot{Z}_2\dot{I}_1}{\dot{Z}_0+\dot{Z}_2}$	$j\sqrt{3}\,\dot{I}_1+\frac{(1-\alpha^2)\dot{Z}_2\dot{I}_1}{\dot{Z}_0+\dot{Z}_1}$
Three-Phase	$\dot{I}_1=\frac{\dot{E}}{\dot{Z}_1}$ $\dot{I}_2=0$	$\sqrt{3}\,\dot{I}_1 e^{j30°}$	$-j\sqrt{3}\,\dot{I}_1$	$-\sqrt{3}\,\dot{I}_1 e^{-j30°}$

* The symbols α, α^2, j, $e^{j30°}$, $e^{-j30°}$ are the well-known operators producing rotations of, respectively 120°, 240°, 90°, 30°, -30°

Fig. 3—Segregation of various fault currents in grounding transformers